New Jersey Department of Environmental Protection
Land Use Management
Post Office Box 409, Trenton
Water Monitoring Project
Water Monitoring and Standards

Leslie J. McGeorge, Administrator

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REAPPRAISAL OF

SHELLFISH GROWING AREA SE-2:

LITTLE BAY TO BEACH THOROFARE

1998 - 2002

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New Jersey Department of Environmental Protection
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EXECUTIVE SUMMARY

The water quality data presented in this Reappraisal Report for Shellfish Growing Area SE-2 were collected between 1998 and 2002. There were 5243 samples collected from 115 sampling stations and were analyzed for Total Coliform (TC) and Fecal Coliform (FC) bacteria. The data gathered for the SE-2 area corresponded to the *Approved* and *Special Restricted* criteria set by the National Shellfish Sanitation Program (NSSP). The water quality of this shellfish growing area was consistent with the current shellfish growing area classification.

INTRODUCTION

PURPOSE

This report is part of a series of studies having a dual purpose. The first and primary purpose is to comply with the guidelines of the National Shellfish Sanitation Program (NSSP) that are established by the Interstate Shellfish Sanitation Conference (ISSC). Reports generated under this program form the basis for classifying shellfish waters for the purpose of harvesting shellfish for human consumption. As such, they provide a critical link in protecting human health.

The second purpose is to provide input to the Integrated Water Quality Monitoring and Assessment Report, which is prepared pursuant to Sections 305(b) and 303(d) of the Federal Clean Water Act (P.L. 95-217). The information contained in the growing area reports is used for the 305b portion of the Integrated Report, which provides an assessment to Congress every two years of current water quality conditions in the State's major rivers, lakes, estuaries, and ocean waters. The reports provide valuable information for the 305(b) portion of the Integrated Report, which describes the waters that are attaining state designated water uses and national clean water goals; the pollution problems identified in surface waters; and the actual or potential sources of pollution. Similarly, the reports utilize relevant information contained in the 305(b) portion of the Integrated Report, since the latter assessments are based on instream monitoring data (temperature, oxygen, pH, total and fecal coliform bacteria, nutrients, solids, ammonia and metals), land-use profiles, drainage basin characteristics and other pollution source information.

From the perspective of the Shellfish Classification Program, the reciprocal use of water quality information from reports represent two sides of the same coin: the growing area report focuses on the estuary itself, while the 305(b) portion of the report describes the watershed that drains to that estuary.

The Department participates in a cooperative National Environmental Performance Partnership System (NEPPS) with the USEPA which emphasizes ongoing evaluation of issues associated with environmental regulation, including assessing impacts on water bodies and measuring improvements in various indicators of environmental health. The shellfish growing area reports are intended to provide a brief assessment of the growing area, with particular emphasis on those factors that affect the quantity and quality of the shellfish resource. The shellfish growing area reports provide valuable information on the overall quality of the saline waters in the most downstream sections of each major watershed. In addition, the reports assess the quality of the biological resource and provide a reliable indicator of potential areas of concern and/or areas where additional information is needed to accurately assess watershed dynamics.

HISTORY

As a brief history, the NSSP developed from public health principles and program controls formulated at the original conference on shellfish sanitation called by the Surgeon General of the United States Public Health Service in 1925. This conference was called after oysters were implicated in causing over 1500 cases of typhoid fever and 150 deaths in 1924. The tripartite cooperative program (federal, state and shellfish industry) has updated the program procedures and guidelines through workshops held periodically until 1977. Because of concern by many states that the NSSP guidelines were not being enforced uniformly, a delegation of state shellfish officials from 22 states met in 1982 in Annapolis, Maryland, and formed the ISSC. The first annual meeting was held in 1983 and continues to meet annually at various locations throughout the United States.

The NSSP *Guide for the Control of Molluscan Shellfish* sets forth the principles and requirements for the sanitary control of shellfish produced and shipped in interstate commerce in the United States. It provides the basis used by the Federal Food and Drug Administration (FDA) in evaluating state shellfish sanitation programs. The five major points on which the state is evaluated by the FDA include:

1. The classification of all actual and potential shellfish growing areas as to their suitability for shellfish harvesting.

2. The control of the harvesting of shellfish from areas that are classified as restricted, prohibited or otherwise closed.

3. The regulation and supervision of shellfish resource recovery programs.

4. The ability to restrict the harvest of shellfish from areas in a public health emergency, and

5. Prevent the sale, shipment or possession of shellfish that cannot be identified as being produced in accordance with the NSSP and have the ability to condemn, seize or embargo such shellfish.

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FUNCTIONAL AUTHORITY

The authority to carry out these functions is divided between the Department of Environmental Protection (DEP), the Department of Health and Senior Services and the Department of Law and Public Safety. The Bureau of Marine Water Monitoring (BMWM), under the authority of N.J.S.A. 58:24, classifies the shellfish growing waters and administers the special resource recovery programs. Regulations delineating the growing areas are promulgated at N.J.A.C. 7:12 and are revised annually. Special Permit rules are also found at N.J.A.C. 7:12 and are revised as necessary.

The Bureau of Shellfisheries, in the Division of Fish and Wildlife, issues harvesting licenses and leases for shellfish grounds under the Authority of N.J.S.A. 50:2 and N.J.A.C. 7:25. This bureau, in conjunction with the BMWM, administers the Hard Clam Relay Program.

The Bureau of Law Enforcement in the DEP (Division of Fish and Wildlife) and the Division of State Police in the Department of Law and Public Safety enforce the provisions of the statutes and rules mentioned above.

The Department of Health and Senior Services is responsible for the certification of wholesale shellfish establishments and, in conjunction with the BMWM, administers the depuration program. See Figure 1.

FIGURE 1: STATE OF NEW JERSEY SHELLFISH AGENCIES

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                              GOVERNOR

         ┌───────────────────────┬──────────────────────┐
  Department of              Department of Health    Department of Law
  Environmental Protection   and Senior Services     and Public Safety

  ┌──────────┬────────────┐           │                      │
 Land Use        Natural & Historical   Division of Consumer   Division of State
 Management      Resources              Health Services        Police

 Water Monitoring   Division of Fish        Shellfish Program     Marine Bureau
 And Standards      & Wildlife

 Bureau of Marine   Marine Fisheries    Bureau of
 Water Monitoring   Administration      Law Enforcement

                    Bureau of           Marine
                    Shellfisheries      Enforcement
                                        Regions
```

LOCATION

Leeds Point	Nacote Creek Bivalve	Nacote Creek	Trenton	Field Stations

ACTIVITIES

Water Monitoring; Special Permits; Classification Charts	Licenses, Leases, Resource Plants	Enforcement: Resource Management, Special Permits	Certified Dealers; Depuration Plants	Enforcement: All New Jersey Statutes

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IMPORTANCE OF SANITARY CONTROL OF SHELLFISH

Emphasis is placed on the sanitary control of shellfish because of the direct relationship between pollution of shellfish growing areas and the transmission of diseases to humans. Shellfish borne infectious diseases are generally transmitted via a fecal-oral route. The pathway is complex and quite circuitous. The cycle usually begins with fecal contamination of the shellfish growing waters. Sources of such contamination are many and varied. Contamination reaches the waterways via runoff and direct discharges.

Clams, oysters and mussels pump large quantities of water through their bodies during the normal feeding process. During this process the shellfish also concentrate microorganisms, which may include pathogenic microbes, and toxic heavy metals/chemicals. It is imperative that a system is in place to reduce the human health risk of consuming shellfish from areas of contamination.

Accurate classifications of shellfish growing areas are completed through a comprehensive sanitary survey. The principal components of the sanitary survey report include:

1. An evaluation of all actual and potential sources of pollution,

2. An evaluation of the hydrography of the area and

3. An assessment of water quality. Complete intensive sanitary surveys are conducted every 12 years with interim narrative evaluations completed on a three-year basis. If major changes to the shoreline or bacterial quality occur, then the intensive report is initiated prior to its l2 year schedule.

The following narrative constitutes this bureau's assessment of the above mentioned components and determines the current classification of the shellfish growing waters.

THE NORTHERN QUAHAUG

Mercenaria mercenaria

(HARD CLAM)
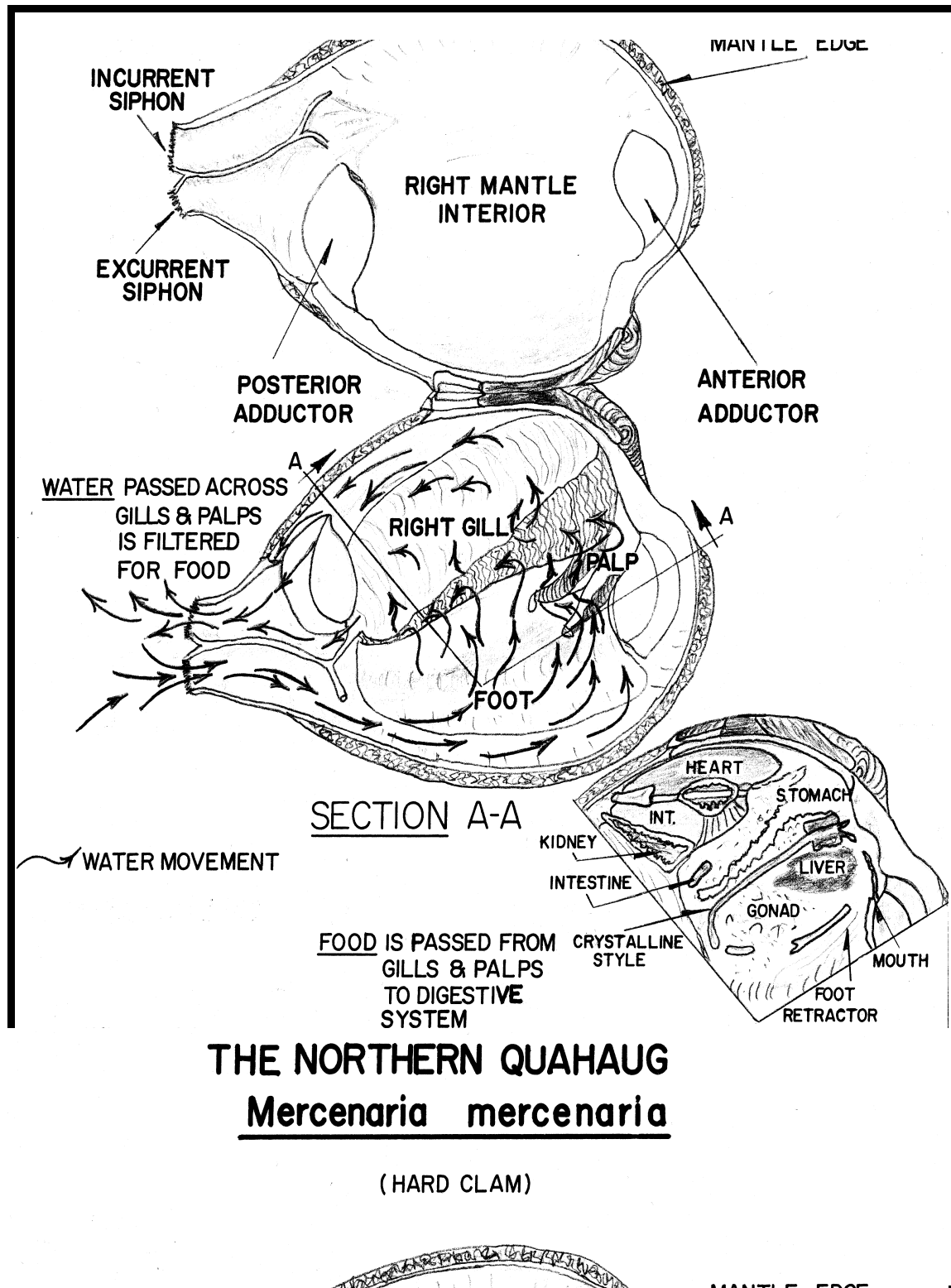
PROFILE

LOCATION

Area of SE-2 is located in Atlantic County, which consists of several main water bodies, channels, thorofares, and inlets. The primary water bodies of SE-2 include Absecon Bay, Reed Bay, and Little Bay. Enclosed in these water bodies are numerous thorofares, channels, and inlets. Some of the larger thorofares and channels are the Absecon Channel, Beach Thorofare, Bonita Tideway, and Brigantine Channel. There are several coves in the SE-2 area, which include the Hammock Cove, Perch Cove, Somers Cove, and Turtle Cove. See Figure 3 for the location of the SE-2 area.

SE-2 is surrounded by the several municipalities, which include Absecon City, Atlantic City, Brigantine City,

Galloway Township, and Pleasantville City. Within these five municipalities, Atlantic City has the highest residential population as well as the most amounts of people living in one square mile. This is mainly due to the expansion of the casino industry.

The expansion of the casino industry in Atlantic City had bought more job opportunities as well as residential population to the city. Population is likely to further increase in future years due to the Borgata Hotel Casino & Spa, which opened on July 3, 2003. See Table 1 for population and source information.

TABLE 1: POPULATION INFORMATION (SOURCE: WWW.CENSUS.GOV)

Community	Area (sq. mi.)	Population Census		2000 Population Density
		2000	1990	
Absecon City	5.72	7,638	7,298	1335
Atlantic City	11.35	40,517	37,986	3570
Brigantine City	6.43	12,594	11,354	1959
Galloway Township	90.43	31,209	23,330	345
Pleasantville City	5.80	19,012	16,027	3278
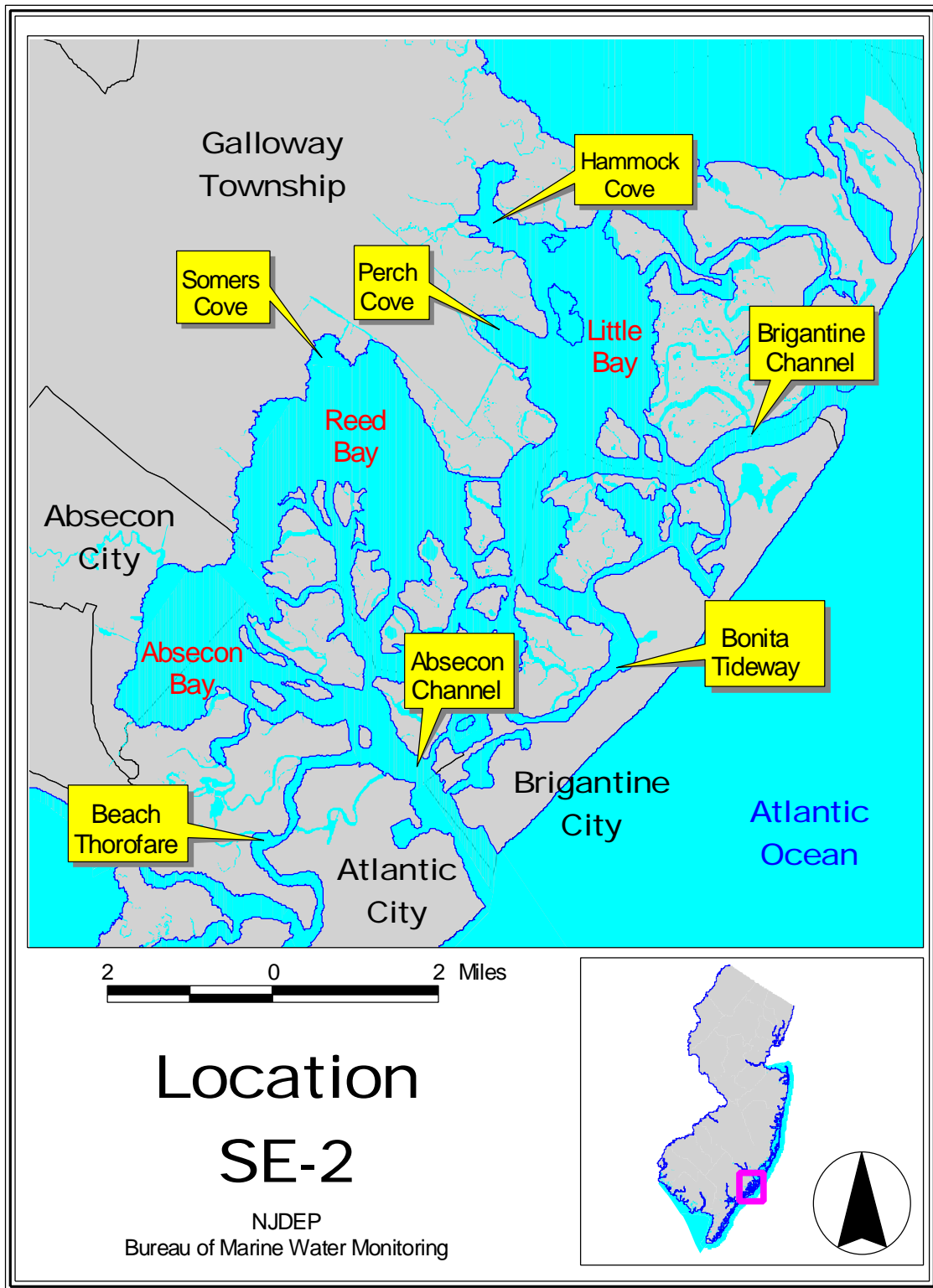
DESCRIPTION

Areas of SE-2 are currently classified as *Approved* year-round, *Seasonally Approved*, *Special Restricted*, and *Prohibited*. It can be found on pages 6 and 7 of the 2002 State of New Jersey Shellfish Growing Water Classification Charts.

The Absecon and Brigantine Inlets act as an entrance for salt water flow and tidal influence to the SE-2 area from the Atlantic Ocean. The only major source of fresh water to this area comes from the Atlantic City Reservoir, which is approximately 4 kilometers northwest of the Absecon Bay. Water from the reservoir flows directly to the Absecon Creek, which then discharges to the Absecon Bay. The Absecon Creek is estimated to be 3.12 miles in distance from the tip of the reservoir to the mouth of the Absecon Bay.

The majority of the waters within SE-2 area are classified as *Approved* year-round. This includes waters in Reeds Bay and Little Bay. The Absecon Bay, Absecon Channel, St. George Thorofare, and Bonita Tideway are classified as *Seasonally Approved* from either January to April or November to April, which means that harvesting is only permitted within this time frame. Waters toward Atlantic City, including Beach Thorofare and Clam Creek, are classified as *Special Restricted* or *Prohibited*.

Shellfish harvested from *Special Restricted* areas must undergo either the Depuration or Relay Process before they can be sold commercially. The Depuration Process involves removing the shellfish from contaminated water and placing them in clean water for several days to purge. This process is normally performed in a depuration plant where it is routinely monitored by state law enforcement. The Relay Process is slightly different from the Depuration Process. In a Relay Process, shellfish that are harvested from *Special Restricted* waters are re-planted in a leased plot in *Approved* waters. The shellfish are left to purge in *Approved* waters for 30 days before they can be re-harvested for commercial use. Figure 4 shows the current Shellfish Classification for this area.

FIGURE 4: CURRENT CLASSIFICATION OF SHELLFISH GROWING AREA SE-2
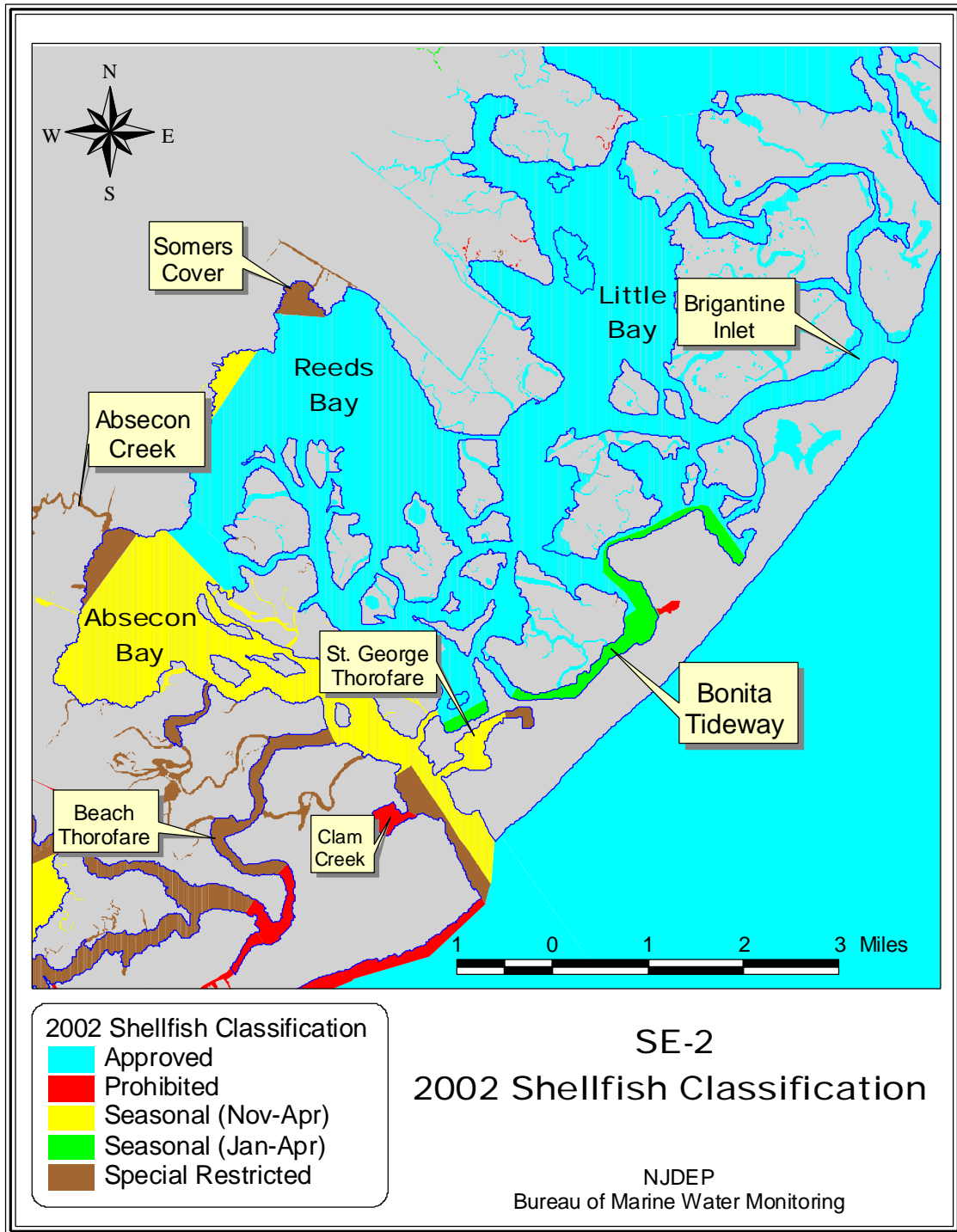
HISTORY

During the 1960's, more than fifty percent of the waters in SE-2 area were classified as *Prohibited*. This included the Absecon Bay, Absecon Channel, Bonita Tideway, Broad Creek, Beach Thorofare, and portion of Reeds Bay. The *Prohibited* classification was initiated by several contributing factors. One of the main attributes was due to the effluent discharge from the Atlantic City and Brigantine City Wastewater Treatment Facilities, which emptied directly into St. Georges Thorofare and Beach Thorofare.

Other contributing factors included malfunctioning septic systems and illegal dumping. During the 1960's and early 1970's, municipalities surrounding the SE-2 area was still on septic systems. The Atlantic County Utilities Authority did not begin its operation until September 18, 1978.

By 1980's, the water quality for the SE-2 area had greatly improved, due to the elimination of the Atlantic City wastewater plant and its discharge to the SE-2 area. A portion of the SE-2 area was then upgraded from *Prohibited* to *Special Restricted* and *Seasonally Approved*. Even though wastewater discharges were significantly reduced, portions of SE-2 are still being threatened by non-point sources, such as storm drains, boating activities, illegal dumping, and malfunctioning septic systems.

METHODS

Water sampling was performed in accordance with the Field Procedures Manual (NJDEP, 1992).

Approximately 5243 water samples were collected for total and fecal coliform bacteria between 1998 and 2002 and analyzed by the three tube MPN method according to APHA (1970). Figure 22 shows the Shellfish Growing Water Quality monitoring stations in the SE-2 area. Approximately 115 stations are monitored during each year.

Water quality sampling, shoreline and watershed surveys were conducted in accordance with the NSSP *Guide for the Control of Molluscan Shellfish,* 1999 Revision.

Data management and analysis was accomplished using database applications developed for the Bureau. Mapping of pollution data was performed with the Geographic Information System (GIS:ARCVIEW®).

BACTERIOLOGICAL INVESTIGATION AND DATA ANALYSIS

The water quality of each growing area must be evaluated before an area can be classified as *Approved, Seasonally Approved, Special Restricted,* or *Seasonal Special Restricted.*

SAMPLING STRATEGY

The State Shellfish Control Authority has the option of choosing one of two water monitoring sampling strategies for each growing area.

The Adverse Pollution Condition Strategy requires that a minimum of five samples be collected each year under conditions that have historically resulted in elevated coliforms in the particular growing area. The results must be evaluated by adding the individual station sample results to the preexisting bacteriological sampling results to constitute a data set of at least 15 samples for each station. The adverse pollution conditions usually are related to tide and rainfall, but could be from a point source of

NSSP CRITERIA

Each shellfish producing state is directed to adopt either the total coliform criterion, or the fecal coliform criterion. While New Jersey bases its growing water classifications on the total coliform criterion, it does make corresponding fecal coliform determinations for each sampling station. These data are viewed as adjunct information and are not directly used for classification.

The criteria were developed to ensure that shellfish harvested from the designated waters would be free of pathogenic (disease-producing) bacteria. Each classification criterion is composed of a measure of the

pollution or variation could occur during a specific time of the year.

The Systematic Random Sampling strategy requires that a random sampling plan be in place before field sampling begins. This strategy can only be used in areas that are not affected by point sources of contamination. A minimum of six samples per station are to be collected each year and added to the database to obtain a sample size of 30 for statistical analysis.

The SE-2 area is sampled under the both Systematic Random Sampling strategy and Adverse Pollution Condition strategy as described above.

statistical 'central tendency' (geometric mean) and the relative variability of the data set. For the Adverse Pollution Condition sampling strategy, variability is expressed as the percentage that exceeds the variability criteria (see Table 2). For the Systematic Random Sampling Strategy, variability is expressed as the 90th percentile (see Table 3).

Areas to be approved under the *Seasonal* classification must be sampled and meet the criterion during the time of the year that it is approved for the harvest of shellfish.

TABLE 2: CRITERIA FOR ADVERSE POLLUTION CONDITION SAMPLING STRATEGY

	Total Coliform Criteria		Fecal Coliform Criteria	
	Geometric mean (MPN/100 mL)	No more than 10% of samples can exceed (MPN/100 mL)	Geometric mean (MPN/100 mL)	No more than 10% of samples can exceed (MPN/100 mL)
Approved Water Classification	70	330	14	49
Special Restricted Water Classification	700	3300	88	300

TABLE 3: CRITERIA FOR SYSTEMATIC RANDOM SAMPLING STRATEGY

	Total Coliform Criteria		Fecal Coliform Criteria	
	Geometric mean (MPN/100 mL)	Estimated 90th percentile (MPN/100 mL)	Geometric mean (MPN/100 mL)	Estimated 90th percentile (MPN/100 mL)
Approved Water Classification	70	330	14	49
Special Restricted Water Classification	700	3300	88	300

MARINE BIOTOXINS

The Department collects samples at regular intervals throughout the summer to determine the occurrence of marine algae that produce biotoxins. See Figure 5, for the location of Phytoplankton sampling stations. Certain planktonic species have the potential to adversely affect the suitability of shellfish for human consumption. These planktonic species cause algal blooms that deplete the dissolved oxygen levels in the water. No algal blooms capable of producing biotoxins were identified for this area. These data are evaluated weekly by the Bureau of Marine Water Monitoring in accordance with the NSSP requirements. An annual report is compiled and is available electronically at: *www.state.nj.us/dep/wmm/bmw*.

FIGURE 5: LOCATION OF PHYTOPLANKTON SAMPLING STATION

New Jersey's
Coastal Phytoplankton
Monitoring Network

Pennsylvania

Delaware

Legend:
- Monitoring Station
- Rivers and Streams
- Land
- Water

New Jersey Department of Environmental Protection
Water Monitoring and Standards
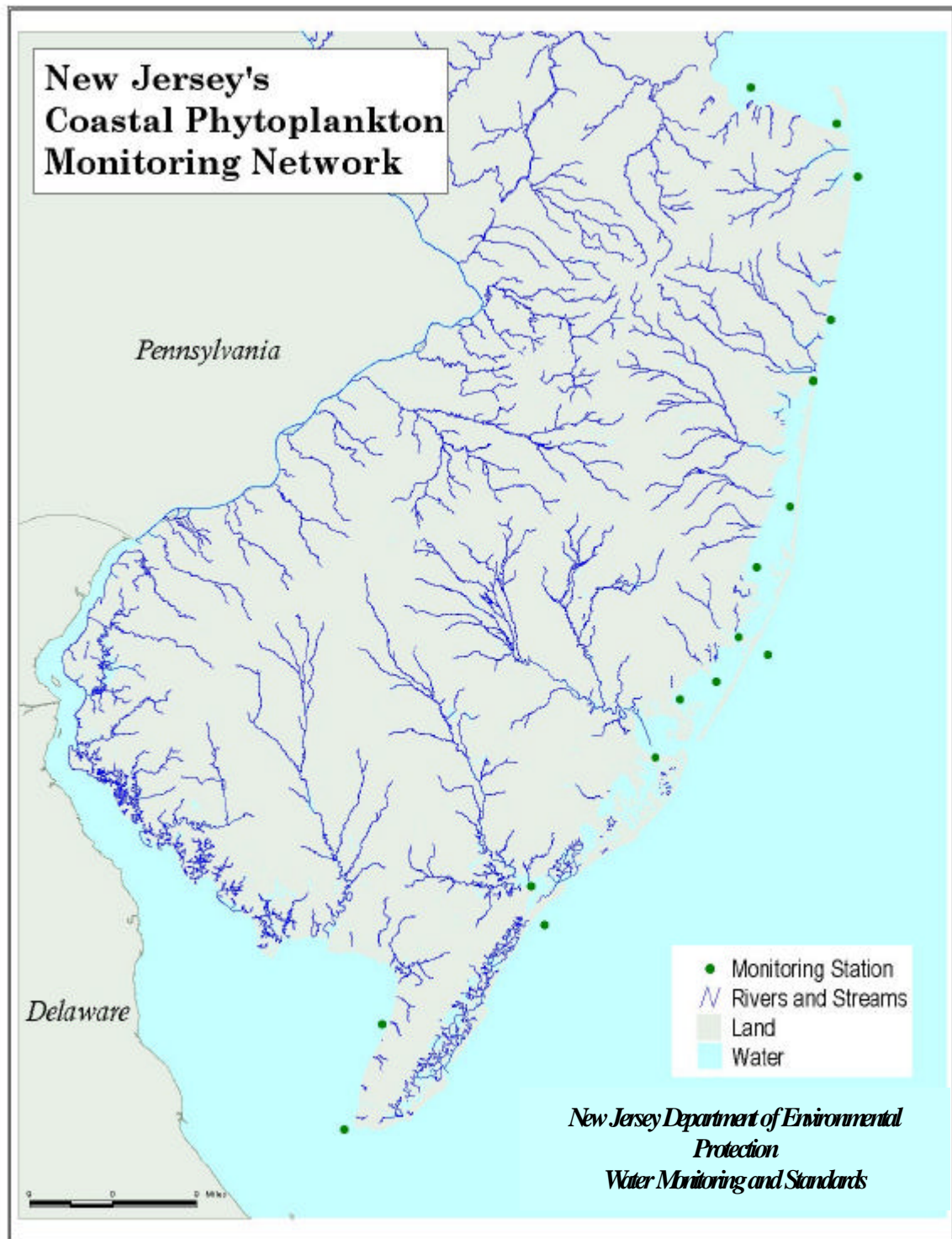
SHORELINE SURVEY

CHANGES SINCE LAST SURVEY

The last survey for the SE-2 area was performed between 1994 and 1997. Since then, there were several new developments that took place in close proximity to the shellfish growing area.   These new developments include the building of the Borgata Hotel Casino & Spa and the Atlantic City Tunnel Project.

The Borgata Hotel Casino & Spa was built near the vicinity of Clam Thorofare and the Atlantic City Tunnel Project took place under Penrose Canal.   During the development process, a temporary closure was issued for this area. The closure resulted from an over flow of untreated sewage into nearby storm water outfalls, which drain directly into Clam Thorofare. The temporary closure was issued from April to May of 1999. Approximately 400 acres of shellfish waters were closed, which included all of the Absecon Channel, Little Panama, Low Water Thorofare, Clam Thorofare, and portion of Beach Thorofare. After which period, the waters were reinstated to their initial classification.

LAND USE

Regions within the SE-2 area are primarily wetland, forest, and or urban development (see Figure 6). A portion of SE-2 is enclosed by wetlands, which acts as a barrier from the surrounding population center.   The wetland acts as a purifier against pollutants and on the other hand utilizes the nutrients obtained for plant growth. By doing so, the wetland helps to reduce pollutants entering into the shellfish growing area.

Municipalities that border the SE-2 area are highly developed.   Absecon City, Pleasantville City, Brigantine City, and Galloway Township consist primarily of residential populations with very few large commercial developments.   However, Atlantic City is highly developed. It is known as the second biggest gambling city in the United States. The casino industry employs thousands of people and brings millions of tourists each year to the area.

The Borgata Hotel Casino & Spa is the newest casino in Atlantic City, which opened on July 3, 2003 (see Figure 7). This new casino was built near the Trump Marina and Harrah's Casino, which are located at the northern end of Atlantic City. As a result of this new expansion, the city had granted and approved the development of the tunnel project.   The tunnel was built in an attempt to connect the Atlantic City Expressway to the White Horse Pike (Route 30), which would provide visitors with an easier route to the Borgata Hotel Casino & Spa, Harrah's Casino, Trump Marina, and Brigantine City.   The development of the tunnel project (Atlantic City Connector) took place under Penrose Canal.

FIGURE 6: LAND USE PATTERNS
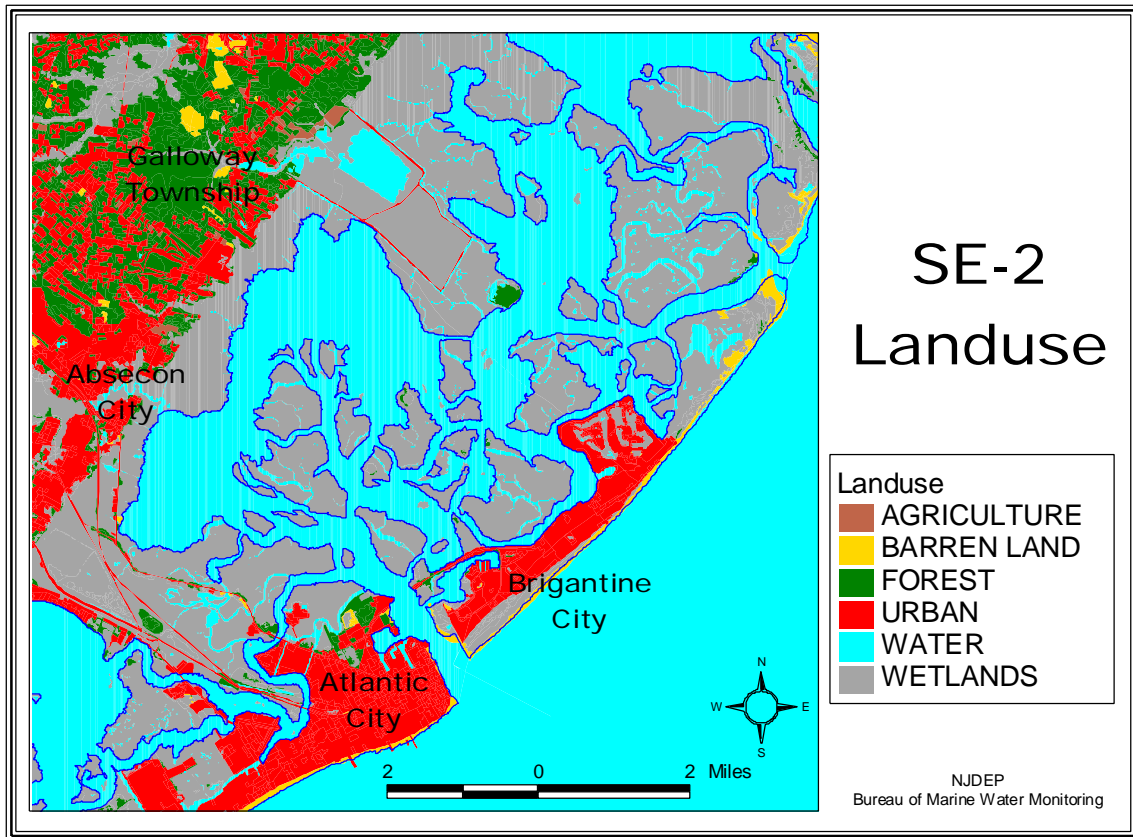
FIGURE 7: THE BORGATA SPA HOTEL & CASINO
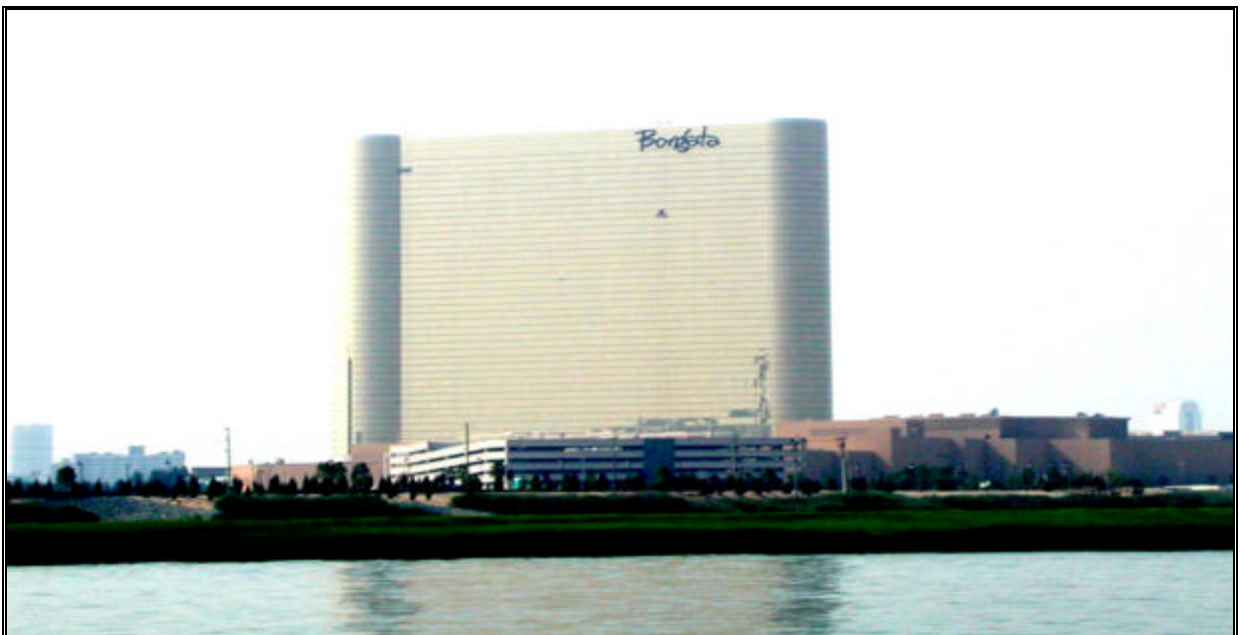
EVALUATION OF BIOLOGICAL RESOURCES

Reeds Bay and Absecon Bay are very shallow, approximately 5-7 feet in depth, which make them very productive in generating hard clams (*Mercenaria mercenaria*). According to past survey conducted in the SE-2 area by the U.S. Fish and Wildlife Service in cooperation with the Bureau of Shellfisheries, in 1963, it was found that there were an abundance of hard clams in the area, which were commercially valuable. The most recent survey, conducted between 1985 and 1990 by the Bureau of Shellfisheries, found average to moderate density of hard clams in Golden Hammock Thorofare, Bonita Tideway, Obes Thorofare, Steelman Bay, and St. George Thorofare.

Area of SE-2 supports a very large seasonal population of waterfowl, wading birds, and shore birds. There are two wildlife refuges found in this area. One is the Edwin B. Forsythe National Wildlife Refuge and the other is the Absecon Wildlife Management Area (see Figure 8). The Edwin B. Forsythe National Wildlife Refuge (see Figure 9) is located ten miles north of Atlantic City. The refuge covers approximately 46,000 acres, which includes portions of the following counties: Atlantic, Burlington, and Ocean. Nearly eighty percent of the refuge is tidal salt meadow and marshes. The remaining acreage is wooded land that is dominated by pitch pines, oaks, and white cedar.

FIGURE 8: LOCATION OF OBSERVED WILDLIFE HABITAT IN SHELLFISH AREA SE-2
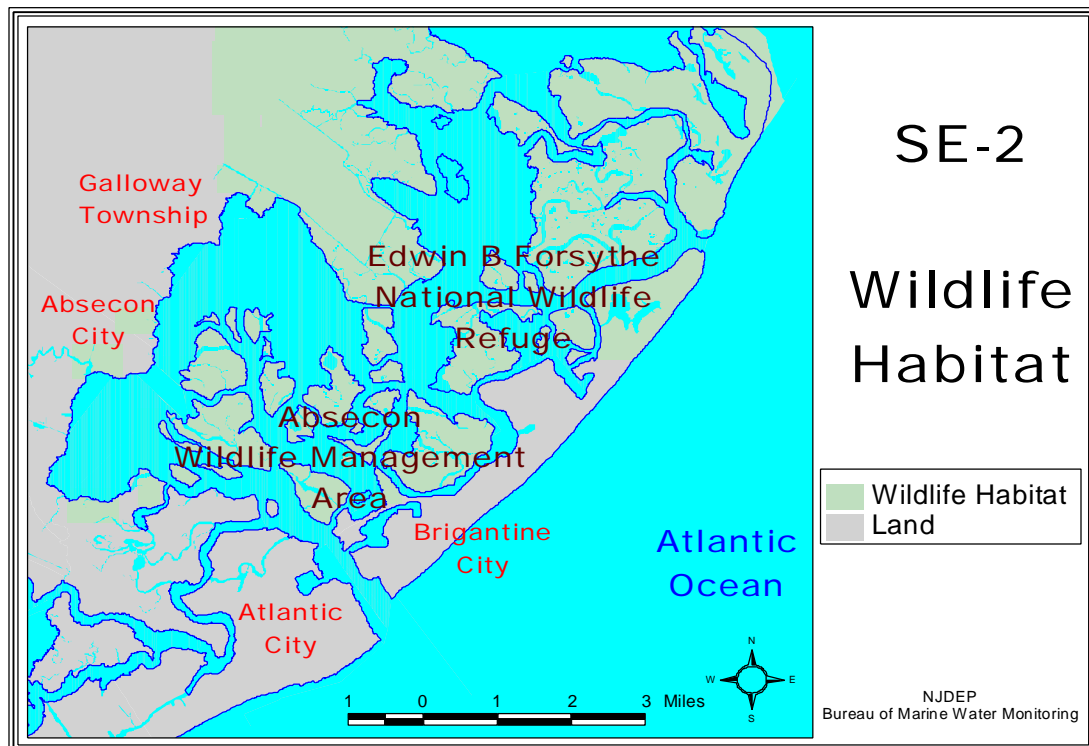
FIGURE 9: EDWIN B. FORSYTHE NATIONAL WILDLIFE REFUGE

IDENTIFICATION AND EVALUATION OF SOURCES

EFFLUENT DISCHARGES

There are no direct discharges to the SE-2 area (see Figure 10). However, there is one wastewater treatment facility located in Atlantic City. The Atlantic County Utilities Authority Wastewater Treatment Plant located at 1801 Absecon Boulevard (see Figure 11). This facility became operational on September 18, 1978, and provides service to the following communities: Absecon, Atlantic City, Brigantine, Egg Harbor City, Egg Harbor Township, Hamilton Township, Linwood, Longport, Margate, Mays Landing, Northfield, Pleasantville, Somers Point, and Ventnor. This facility discharges its treated effluent to the Atlantic Ocean (see Table 4). The discharge pipe is approximately 1.59 miles off the shore, on Raleigh Avenue in Atlantic City. Since the discharge is directed to the Atlantic Ocean, there is no direct impact onto the SE-2 area.

FIGURE 10: ACUA DISCHARGES POINT
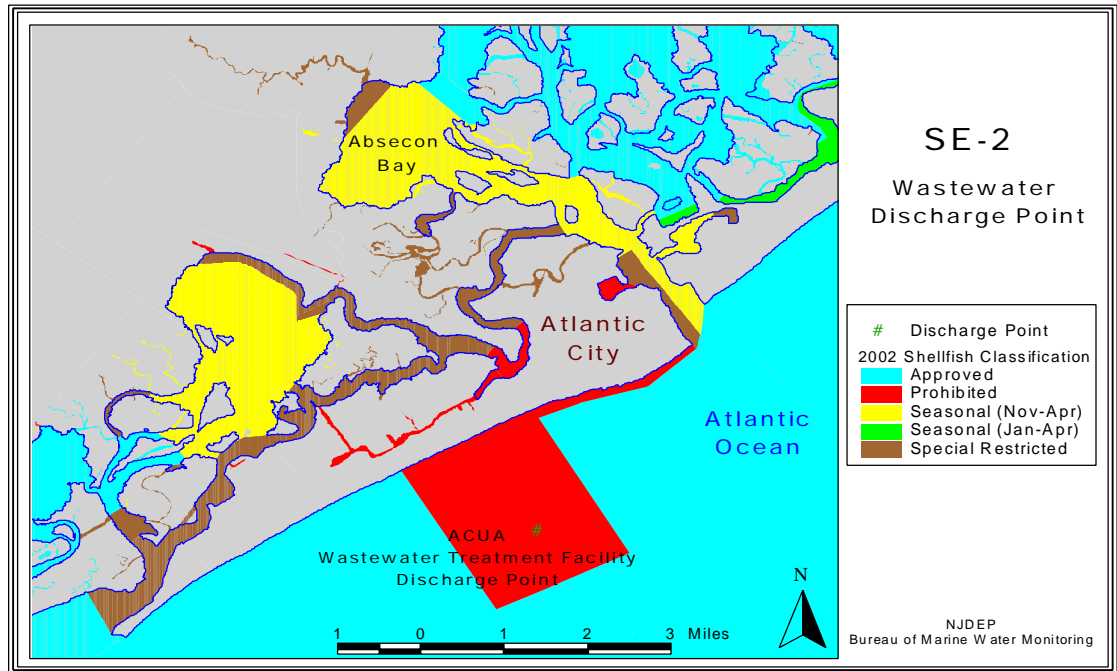
FIGURE 11: ATLANTIC COUNTY UTILITIES AUTHORITY

TABLE 4 : DISCHARGES FACILITY IN THE SHELLFISH GROWING AREA SE-2

Discharge Facility	Waste Type	Waste Quantity (MGD)
Atlantic County Utilities Authority	Sanitary	29.5

INDIRECT DISCHARGES

Indirect discharges are defined as sites and properties within the state where contamination of soil or ground water has been identified or where there has been, or there is suspected to have been, a discharge of contamination.

Known contaminated sites are reported throughout the SE-2 area (see Figure 12). Very few of those sites are located in close proximity to the shellfish growing area. The sites that are located near the shoreline are usually service stations that have underground storage tanks, which may have leaked. Any underground discharges are absorbed by the soil surrounding the tank, which leaves very little impact to the surrounding water. There were several indirect discharges recorded between 1998-2001 for the SE-2 area. However, the impact did not result in the closure of any waters. There was one spill that resulted in closure of shellfish waters. See section on Spills and Unpermitted Discharges for further detail.

FIGURE 12: INDIRECT DISCHARGES TO SHELLFISH GROWING AREA SE-2
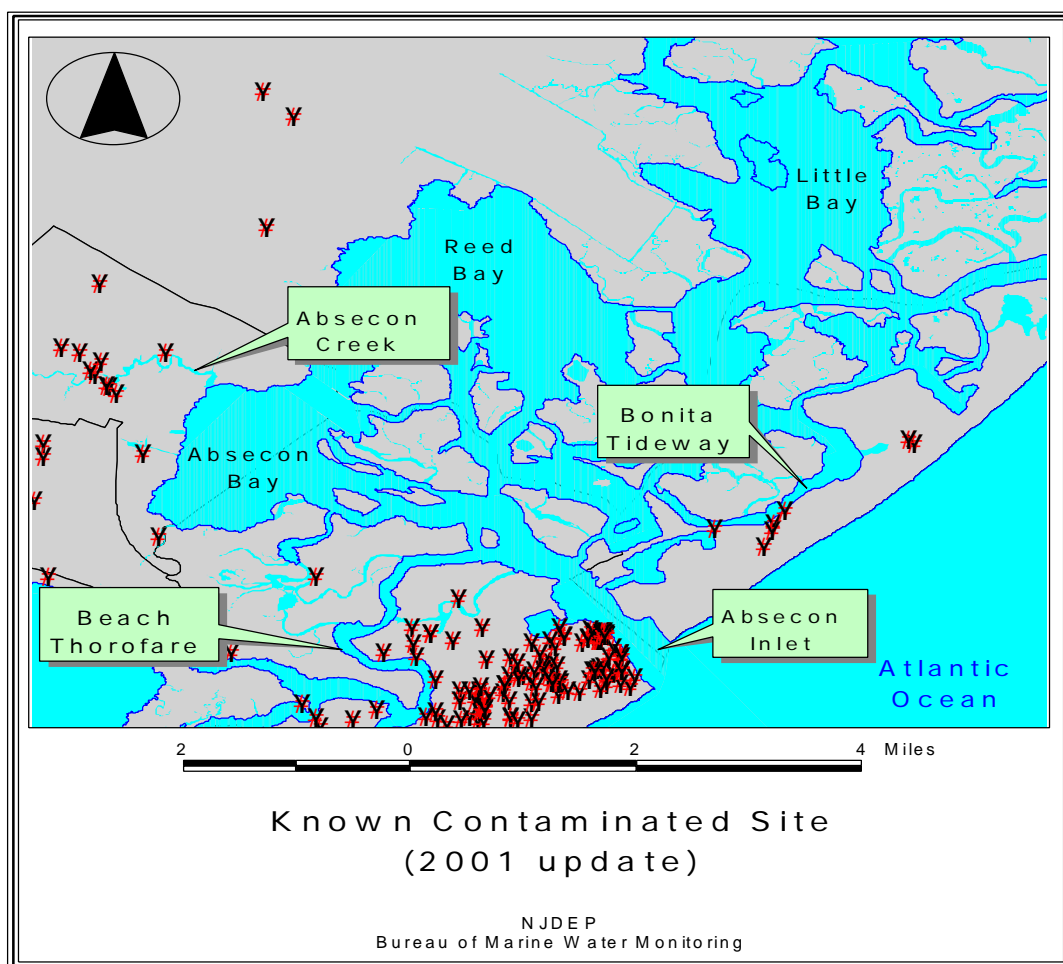
STORM WATER INPUTS

Most of the residential population and urban development are located within the five municipalities that border the SE-2 area. Therefore, there are numerous outfalls surrounding the area (see Figure 13). Major concerns are placed on the storm water outfalls that are situated in close proximity to the shellfish growing waters. When heavy rainfall occurs, bacteria, feces from domestic animals, and wastes from the streets are deposited into these outfalls, which then flushes out onto the shellfish growing area, thus polluting the surrounding waters.

Figure 14, shows the storm water outfalls that are situated within the vicinity of the shellfish growing area. There are two areas of concern for the SE-2 area, Absecon City and Brigantine City. These areas contain numerous storm water outfalls that have the potential for flushing waste directly onto the shellfish growing area. The impacted waters include the Absecon Bay, Bonita Tideway, and St. George Thorofare. However, historical data indicated that the storm water outfalls have not caused a major problem to the water quality within the SE-2 area.

FIGURE 13: STORM WATER OUTFALLS IN SHELLFISH GROWING AREA SE-2
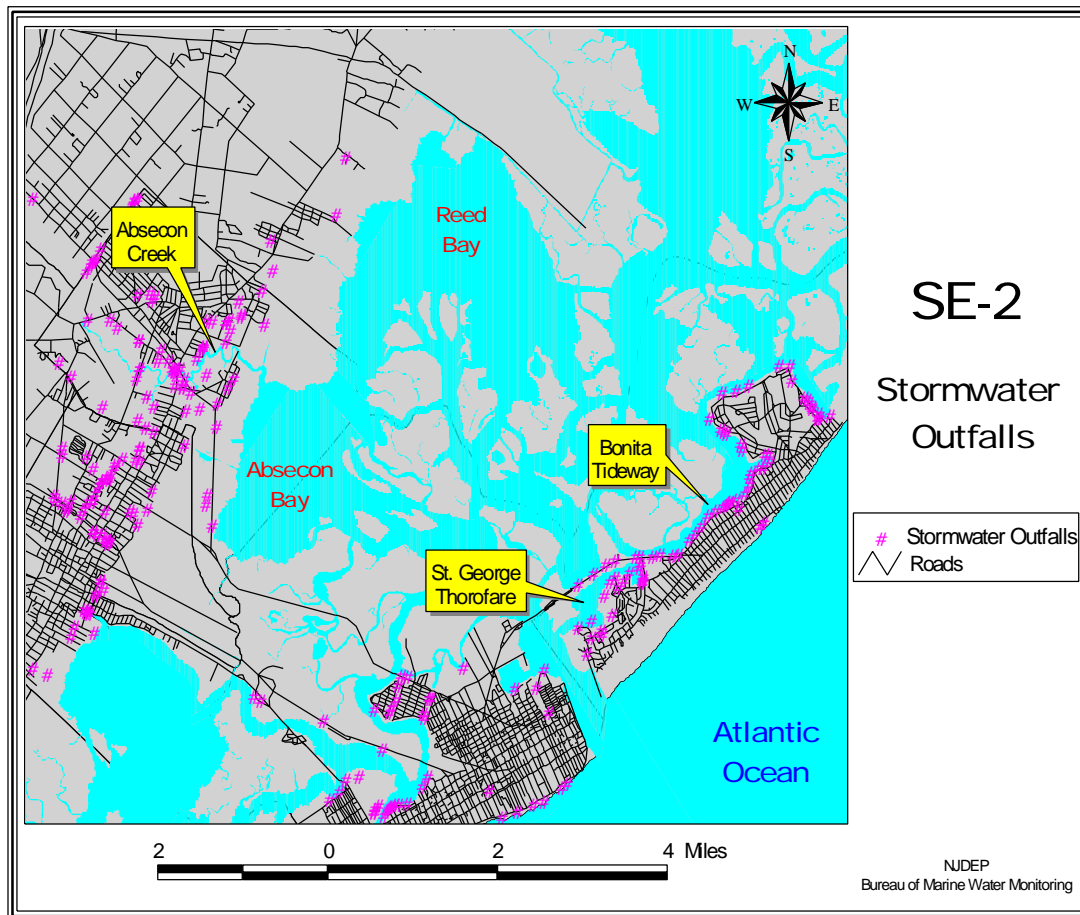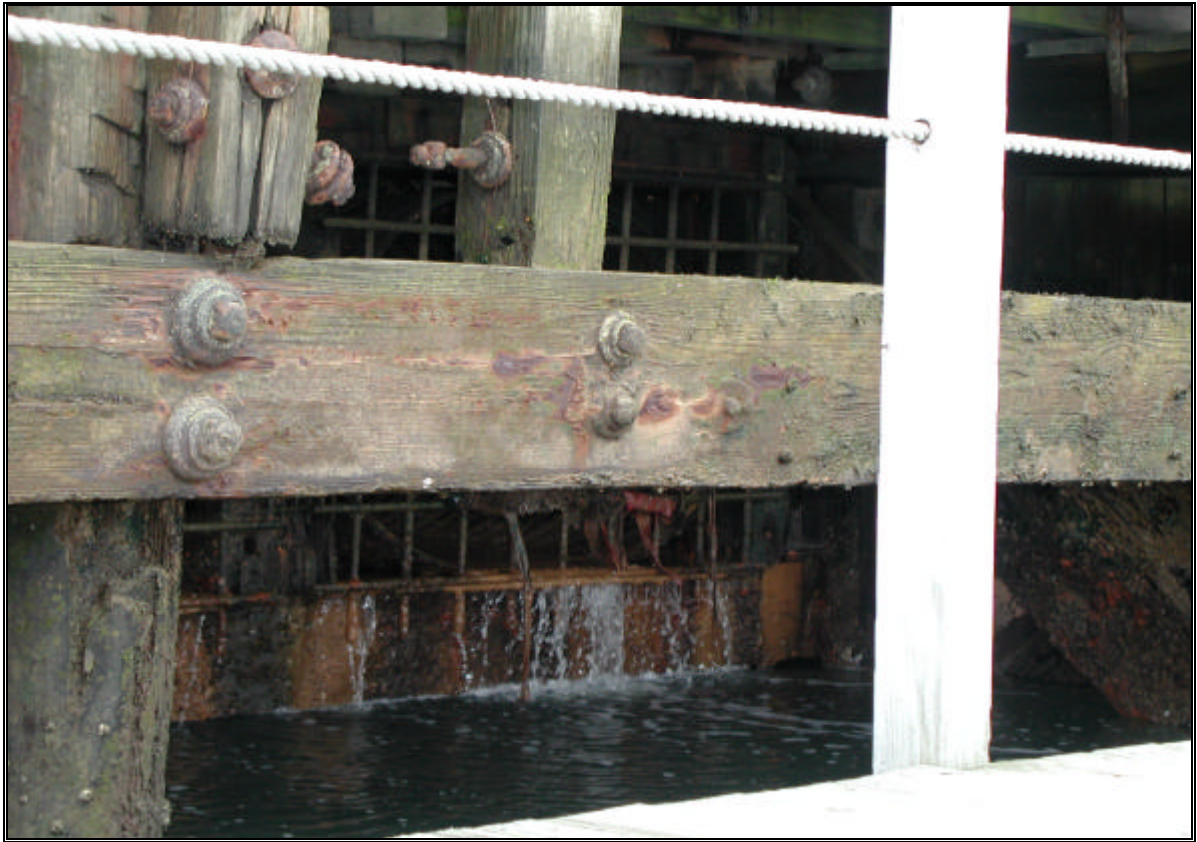
MARINAS

Marina facilities have the potential to affect the suitability of shellfish growing areas for the harvest of shellfish. The biological and chemical contamination associated with marina facilities may be of public health significance. New Jersey defines a marina as "any structure (docks, piers, bulkheads, floating docks, etc.) that supports five or more boats, built on or near the water, which is utilized for docking, storing, or otherwise mooring vessels and usually but not necessarily provides services to vessels such as repairing, fueling, security or other related activities". The

confines of the marina are designated as *Prohibited* for the harvest of shellfish. Adjacent waters are classified using a dilution analysis formula.

It is recognized by the NSSP *Guide for the Control of Molluscan Shellfish,* 1997, that there are significant regional differences in all factors that affect marina pollutant loading. The manual therefore allows each state latitude in applying specified occupancy and discharge rates. The NSSP guidelines assume the worst case scenario for each factor.

EQUATION 1 :MARINA BUFFER EQUATION. (ADAPTED FROM FDA. 1989):

$$BufferRadius(ft)\ ?\ \sqrt{\frac{2x10^9(FC/person/day)x2(person/boat)x[(.25slips\ ?\ 24')\ ?\ (0.065\ ?\ slips\ ?\ 24')]x2}{140000(FC/M^3)xdepth(ft)x0.3048(M/ft)x?x2(tides/day)}}x3.28(ft/M)$$

Explanation of terms in equation:

Fecal coliform per person per day:	2×10^9
Number of people per boat:	2
For slips able to accommodate boats > 24 feet (combination of factors yields multiplier of 0.25):	
Number of slips occupied:	50%
Number of boats occupied:	50%
For boats < 24':	6.5% discharge waste
Angle of shoreline:	180°, which results in factor of 2
Number of tides per day:	2
Depth in meters:	depth in feet x conversion factor
Water quality to be achieved:	140000 FC/meter^3
Convert meters to feet:	3.28

Marina buffer zones may be calculated using the formula above, or may be determined using a dilution analysis computer program developed by the State of Virginia and the USFDA. The formula above considers only dilution and occupancy rates. The computer program, which is used for complex configurations where the formula is unlikely to provide the needed accuracy, also considers tidal exchange and bacterial die-off.

There are 21 marinas in the SE-2 area, as shown in Table 5. There are three marinas located by the Absecon Creek, which includes the Absecon Bay Sportmans Center, Up the Creek Marina, and Waynes World Bait & Marina. Seven marinas are located in Atlantic City by Clam Creek. The remaining marinas are scattered throughout Brigantine City by the Bonita Tideway, Steelman Bay, and Broad Creek (see Figure 15). The biggest marina in this area is the Farley State Marine, which is located by Trump Marina. This marina has approximately 640 slips (see Figure 16). The waters surrounding these marinas are classified as *Prohibited*; depending on the size of the marina and the water quality, water immediately adjacent to each marina may be classified as *Prohibited*, *Special Restricted*, or *Seasonally Approved* (no harvest during summer months when the marina is active). Marina buffer zones were calculated using the method described above. The size of each buffer zone is shown in Table 5.

FIGURE 15: MARINA FACILITIES IN SHELLFISH GROWING AREA SE-2
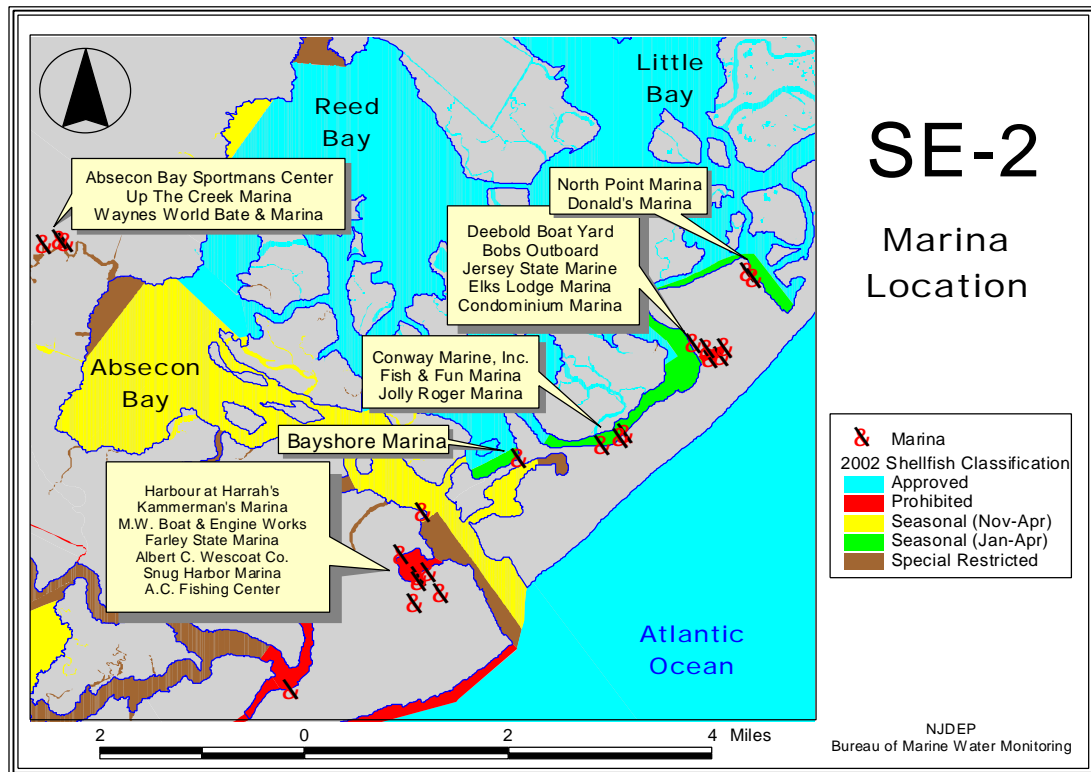
FIGURE 16: FARLEY STATE MARINA

TABLE 5: MARINA FACILITIES LOCATED IN SHELLFISH GROWING AREA SE-2

	Marina Name	Location	Total Slips	# of Slips above 24 ft	Depth (ft)	Size of Buffer Area (radius; feet)
1	Waynes World Bait & Tackle	Absecon	21	21	4	649
2	Up the Creek Marina	Absecon	35	35	4	838
3	Absecon Bay & Sportman Center	Absecon	20	20	4	634
4	Jersey State Marina	Brigantine	38	38	15	451
5	Condominium Marina	Brigantine	38	38	15	451
6	Elks Lodge Marina	Brigantine	50	50	15	517
7	Deebold Boat Yard	Brigantine	21	21	15	335
8	Bobs Outboard	Brigantine	24	24	15	358
9	Donalds Marina	Brigantine	24	24	16	347
10	Jolly Roger Marina	Brigantine	18	18	17	292
11	Fish & Fun Marina	Brigantine	22	22	18	313
12	Conway Marina	Brigantine	25	25	20	317
13	Bayshore Marina	Brigantine	50	50	10	634
14	North Point Marina	Brigantine	30	9	16	269
15	M & W Boat Works	Atlantic City	11	11	12	271
16	Snug Harbor Marina	Atlantic City	7	7	12	216
17	Kammerman's Marina	Atlantic City	8	8	12	231
18	AC Wescoat Co.	Atlantic City	0	0	12	0
19	Farley State Marina	Atlantic City	640	640	6	2926
20	Harrah's Marina	Atlantic City	107	107	12	846
21	AC Fishing Center	Atlantic City	12	12	12	283

SPILLS OR OTHER UNPERMITTED DISCHARGE

There were several spills recorded between 1998 and 2002, but only one resulted in a temporary closure of shellfish waters within the SE-2 area (see Figure 17). This temporary closure was issued for all of the Absecon Channel, Little Panama, Low Water Thorofare, Penrose Canal, Clam Creek, and a portion of Beach Thorofare. The closure resulted from an over flow of untreated sewage into Clam Thorofare. The temporary closure was issued from April to May of 1999.

FIGURE 17: SPILLS OR OTHER UNPERMITTED DISCHARGES
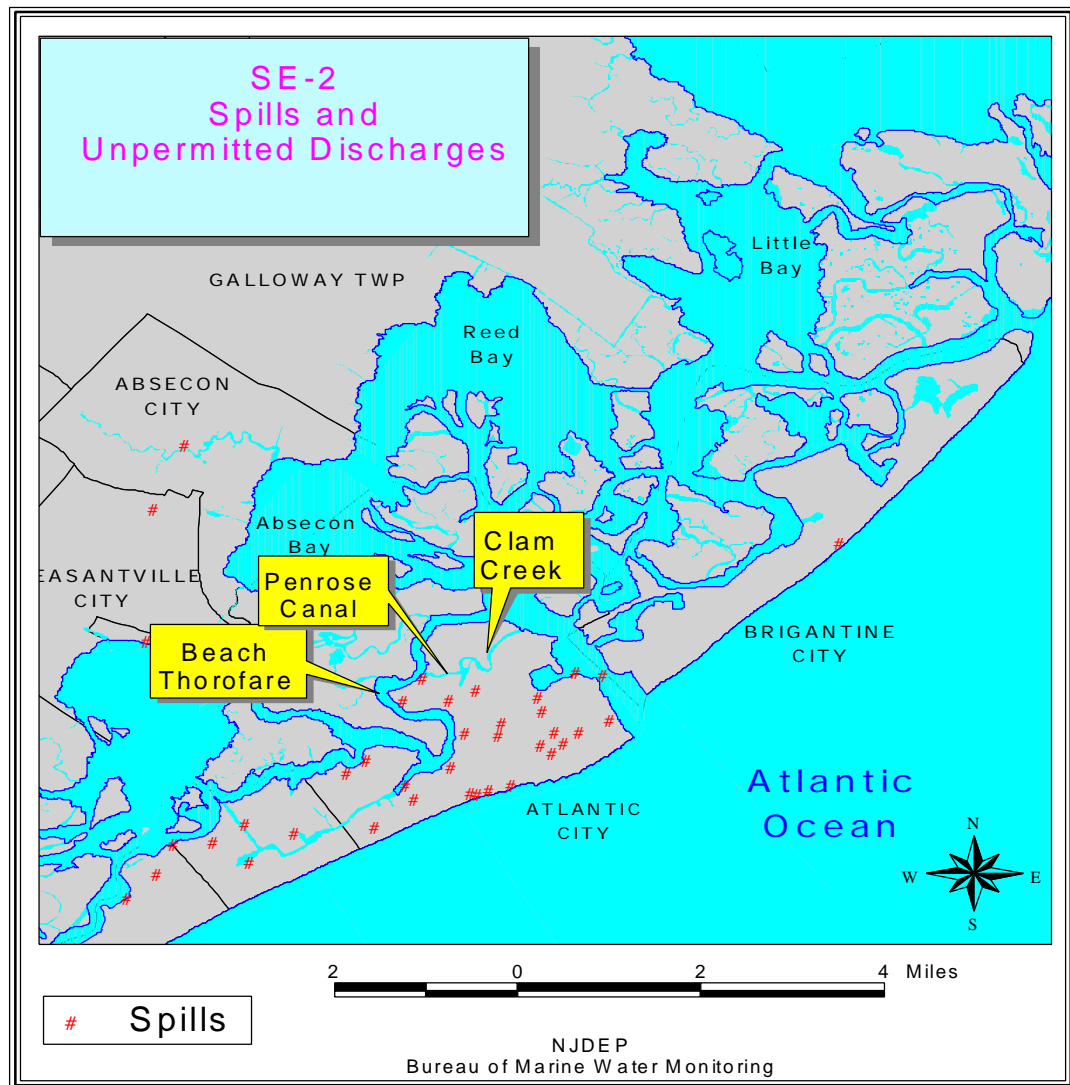
HYDROGRAPHY AND METEOROLOGY

PATTERNS OF PRECIPITATION

Precipitation patterns in the coastal areas of New Jersey are typical of the Mid-Atlantic coastal region. Typical summer storms are localized storms associated with thunderstorms. Winter storms are frequently associated with northeasters. Hurricanes can occur during the summer and early fall.

Between 1998 and 2002, there were only two hurricanes that came in close proximity to the SE-2 area, Hurricane Floyd in 1999 and Hurricane Gordon in 2000 (see Figures 18-22). By the time these

hurricanes reached the coast of New Jersey, they had lost their intensity and were downgraded to tropical storms. None of the samples collected after these storms exhibited high bacteriological results.

A detailed hydrographic report was completed for the 1998-2002 Growing Area Report. Precipitation inputs to the area from 1998 through 2002 are shown in Table 6. The primary weather station for this area is located at the Atlantic City International Airport.

FIGURE 18: 1998 HURRICANE TRACKING MAP
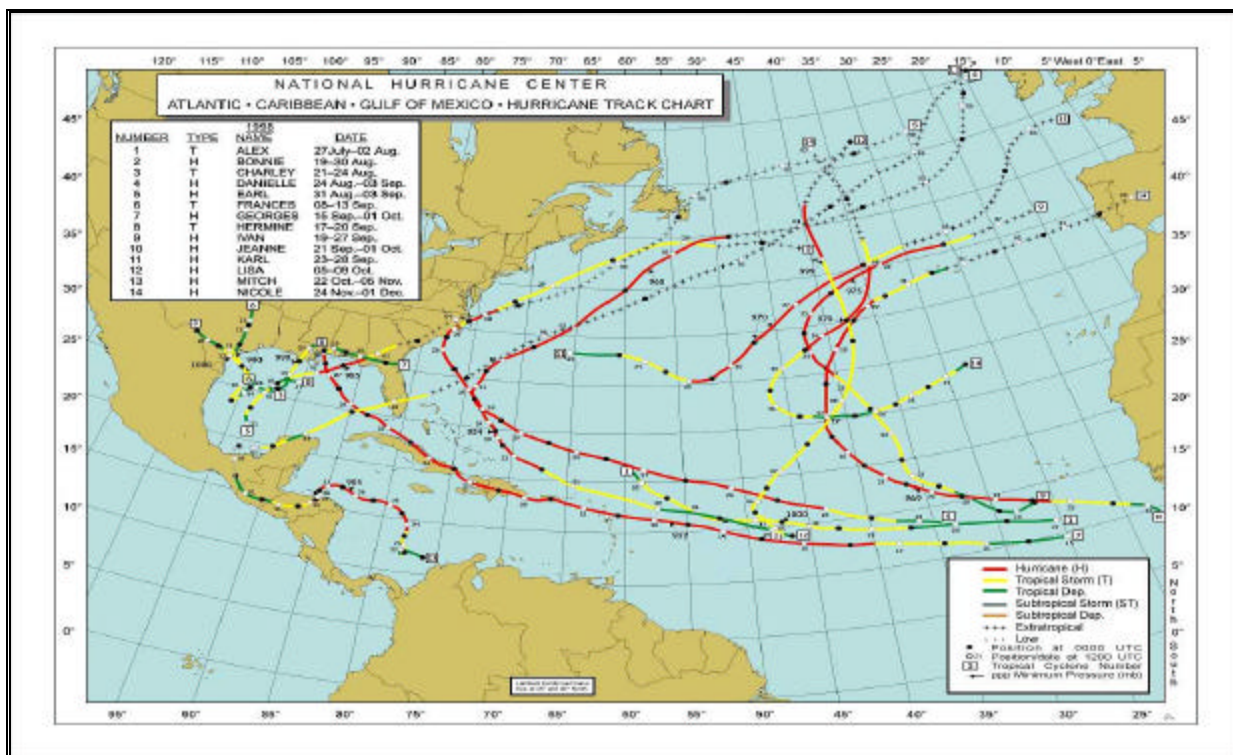
FIGURE 19: 1999 HURRICANE TRACKING MAP
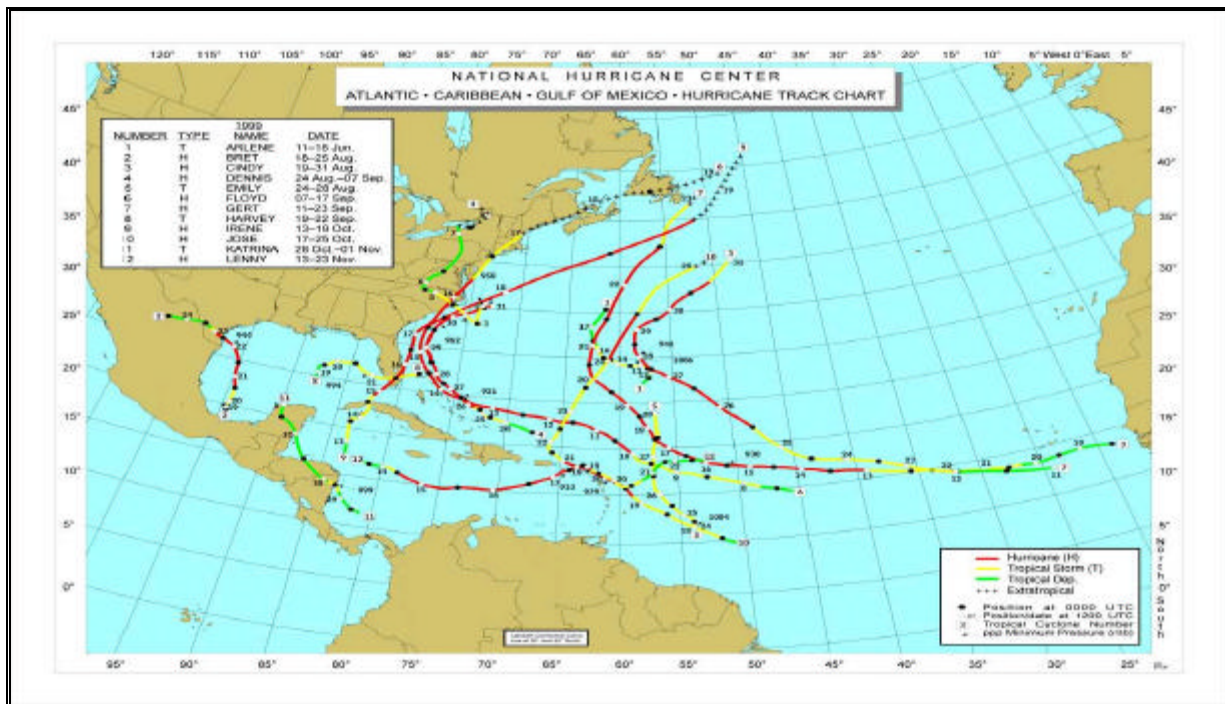
FIGURE 20: 2000 HURRICANE TRACKING MAP

FIGURE 21: 2001 HURRICANE TRACKING MAP

FIGURE 22: 2002 HURRICANE TRACKING MAP

TABLE 6: CLIMATOLOGICAL DATA
Rainfall Recorded at NOAA's Station 311

SAMPLING DATE	PRECIPITATION			AVERAGE TEMP. (F)
	DAY OF SAMPLING	DAY OF + 1 DAY BEFORE	DAY OF + 2 DAYS BEFORE	
1/26/1998	0	0.01	0.23	34
2/9/1998	0	0	0	36
2/27/1998	0	0	0	43
3/27/1998	0	0.005	0.005	68
4/15/1998	0	0.06	0.06	62
4/24/1998	0.005	0.845	0.845	59
5/14/1998	0	0	0.82	51
5/21/1998	0	0	0.005	73
6/9/1998	0	0	0	63
6/10/1998	0.005	0.005	0.005	63
6/26/1998	0.15	0.15	0.15	82
7/21/1998	0	0	0	83
8/6/1998	0	0	0	73
8/21/1998	0	0	0	72
9/18/1998	0	0	0	70
9/24/1998	0	0	0.005	55
10/19/1998	0	0	0	62
10/20/1998	0	0	0	58
11/18/1998	0	0	0	42
11/19/1998	0	0	0	44
12/4/1998	0	0	0	63
12/8/1998	0.32	0.35	0.35	51
3/1/1999	0.13	0.81	0.815	41
3/2/1999	0	0.13	0.81	40
3/3/1999	0.19	0.19	0.32	43
3/5/1999	0	0.01	0.2	35
3/16/1999	0	0.27	1.77	41
3/23/1999	0.01	0.36	1.31	42
3/30/1999	0	0	0.15	49
4/5/1999	0	0.29	0.29	45

SAMPLING DATE	PRECIPITATION			AVERAGE TEMP. (F)
	DAY OF SAMPLING	DAY OF + 1 DAY BEFORE	DAY OF + 2 DAYS BEFORE	
4/15/1999	0.14	0.14	0.14	49
4/16/1999	0.12	0.26	0.26	44
4/22/1999	0.27	0.28	0.38	56
4/26/1999	0	0	0	59
4/28/1999	0	0	0	46
4/29/1999	0	0	0	51
4/30/1999	0	0	0	48
5/26/1999	0	0.005	0.415	64
6/15/1999	0.06	0.44	0.48	71
7/27/1999	0	0.005	0.005	81
8/12/1999	0	0	0	80
8/20/1999	0.05	0.05	0.05	72
9/22/1999	0.005	0.325	0.325	59
9/27/1999	0	0	0	65
10/12/1999	0	0.005	0.325	53
10/15/1999	0	0	0.005	48
10/18/1999	0.21	1.33	1.33	53
10/25/1999	0	0	0.04	48
11/9/1999	0	0	0	48
11/29/1999	0	0	0	40
12/13/1999	0.4	0.4	0.4	39
12/14/1999	1.05	1.45	1.45	48
1/6/2000	0	0.03	0.78	33
1/13/2000	0.11	0.11	0.115	36
2/22/2000	0	0	0	36
2/28/2000	0.23	0.24	0.24	48
2/29/2000	0	0.23	0.24	45
3/6/2000	0	0	0	45
3/9/2000	0	0	0	63
3/24/2000	0	0	1.15	50
4/6/2000	0.005	0.005	0.205	53
4/7/2000	0	0.005	0.005	53

SAMPLING DATE	PRECIPITATION			AVERAGE TEMP. (F)
	DAY OF SAMPLING	DAY OF + 1 DAY BEFORE	DAY OF + 2 DAYS BEFORE	
4/24/2000	0	0.005	0.015	58
4/26/2000	0	0.42	0.42	45
4/28/2000	0	0.01	0.01	49
5/11/2000	0	0.15	0.15	64
5/17/2000	0.03	0.03	0.03	61
6/13/2000	0	0.27	0.27	61
6/19/2000	0	1.1	1.1	67
6/20/2000	0	0	1.1	69
7/6/2000	0	0	0.23	69
7/17/2000	0.01	0.02	1.64	74
7/25/2000	0.1	0.12	0.12	68
8/17/2000	0	0.005	0.015	67
8/18/2000	0.55	0.55	0.555	66
9/15/2000	0.19	0.19	0.195	65
9/20/2000	0.005	0.465	0.465	72
10/6/2000	0	0	0	70
10/12/2000	0	0	0	55
10/17/2000	0	0	0	61
11/1/2000	0	0	0	50
12/11/2000	0.21	0.21	0.22	41
1/11/2001	0.005	0.005	0.285	37
1/18/2001	0	0	0.01	33
2/23/2001	0	0.15	0.15	30
2/27/2001	0	0	0.33	39
3/2/2001	0	0	0.01	40
3/9/2001	0.27	0.27	0.27	39
3/12/2001	0.55	0.55	0.55	34
3/22/2001	0.09	1.66	1.73	44
3/23/2001	0	0.09	1.66	49
4/9/2001	0.19	0.19	0.19	69
4/26/2001	0	0	0.01	46
5/7/2001	0	0	0	49

SAMPLING DATE	PRECIPITATION			AVERAGE TEMP. (F)
	DAY OF SAMPLING	DAY OF + 1 DAY BEFORE	DAY OF + 2 DAYS BEFORE	
5/14/2001	0	0	0	57
5/18/2001	0	0	0	60
6/25/2001	0	0.02	0.04	71
7/2/2001	0	0	0.005	64
7/9/2001	0	0	0	77
7/23/2001	0	0	0	75
8/8/2001	0	0	0	88
8/17/2001	0	0.01	0.01	80
9/7/2001	0	0	0	69
9/17/2001	0	0	0	62
9/18/2001	0	0	0	66
10/4/2001	0	0	0	71
10/10/2001	0	0	0	54
10/16/2001	0.03	0.2	0.28	54
11/1/2001	0.19	0.19	0.19	54
12/7/2001	0	0	0	55
12/14/2001	0.01	0.02	0.04	59
1/3/2002	0	0	0	30
1/11/2002	0.36	0.36	0.365	44
2/1/2002	0.05	0.16	0.215	56
2/14/2002	0	0	0	27
2/27/2002	0.05	0.05	0.05	38
3/14/2002	0`	0.29	0.34	54
3/20/2002	1.59	1.59	2.12	48
4/18/2002	0.04	0.04	0.04	76
4/24/2002	0	0	0.11	44
4/29/2002	0	2.29	2.38	52
5/10/2002	0	0.07	0.07	67
5/31/2002	0.14	0.14	0.14	72
6/13/2002	1.42	1.75	1.75	64
6/18/2002	0	0	0	66
6/25/2002	0.01	0.06	0.06	81

SAMPLING DATE	PRECIPITATION			AVERAGE TEMP. (F)
	DAY OF SAMPLING	DAY OF + 1 DAY BEFORE	DAY OF + 2 DAYS BEFORE	
7/11/2002	0	0	0.55	66
7/22/2002	0	0	0.01	77
7/24/2002	0.05	0.1	0.1	71
8/21/2002	0	0	0	74
9/5/2002	0	0	0	71
9/11/2002	0	0	0.01	66
9/19/2002	0	0	0	66
10/7/2002	0.005	0.005	0.015	65
10/22/2002	0	0	0.01	49
10/28/2002	0.005	0.005	1.695	47
11/20/2002	0	0	0	45
12/6/2002	0	0	0	28
12/11/2002	0	0	0	41

WATER QUALITY STUDIES

BACTERIOLOGICAL QUALITY

A total of 5243 samples were collected and analyzed for Total Coliform (TC) and Fecal Coliform (FC) from 115 sampling stations listed in Assignment 167, 172, and part of Assignment 197. Both Assignments 167 and 172 were sampled under the Systematic Random strategy (SRS), while Assignment 197 was sampled preferably at ebb tide under the Adverse Pollution Condition strategy (APC). There were approximately 34 APC and 81 SRS sampling stations in the SE-2 area (see Figure 23). This report included data analyzed between January 1998 to December 2002 (see Table 7 & 8). The summary of all the raw data is provided in the Appendix. The National Shellfish Sanitation Program (NSSP) criteria can be found on Table 2 and Table 3.

COMPLIANCE WITH NSSP APPROVED CRITERIA

Approved Year- Round

There are approximately 56 sampling stations situated in *Approved* waters. There was no sampling station in *Approved* waters that failed to meet the NSSP Approved criteria.

Seasonally Approved

A large portion of the waters within the Absecon Bay and Absecon Channel are currently classified as *Seasonally Approved* from November to April. Waters within the Bonita Tideway are also *Seasonally Approved*, but from January to April. Harvesting of shellfish in these areas are only permitted from either November to April or January to April when most of the boating activities are limited due to the winter season. There were no stations in these areas that detected a high Total Coliform count. The results indicated that all stations were within NSSP Seasonally Approved criteria for Total Coliform and therefore, met the current shellfish classification.

COMPLIANCE WITH NSSP SPECIAL RESTRICTED CRITERIA

There were six sampling stations in the *Special Restricted* area located within the vicinity of Beach Thorofare and St. Georges Thorofare that exhibited high Total Coliform counts (see Figure 24). These stations were 2417C, 2418A, 2418C, 2418E, 2419A, and 2420, which were all APC sampling stations. Five stations exhibited high Total Coliform counts year-round (2418A, 2418C, 2418E, 2419A, and 2420) and the other station (2417C) only failed to meet the criteria for the summer season. While these stations failed to meet the NSSP *Approved* criteria, they were acceptable for the NSSP *Special Restricted* specification.

FIGURE 23: SAMPLING STATIONS IN SHELLFISH GROWING AREA SE-2
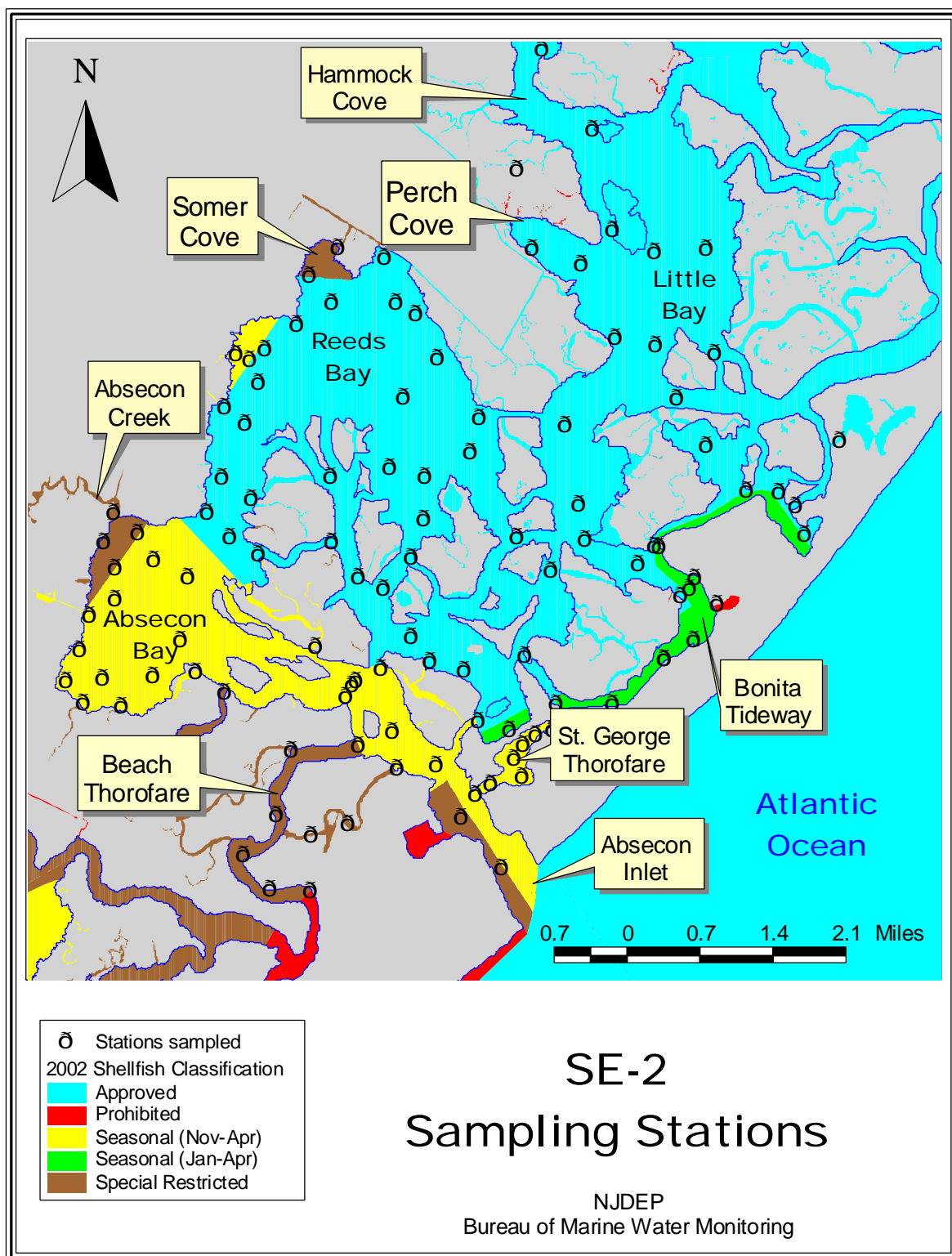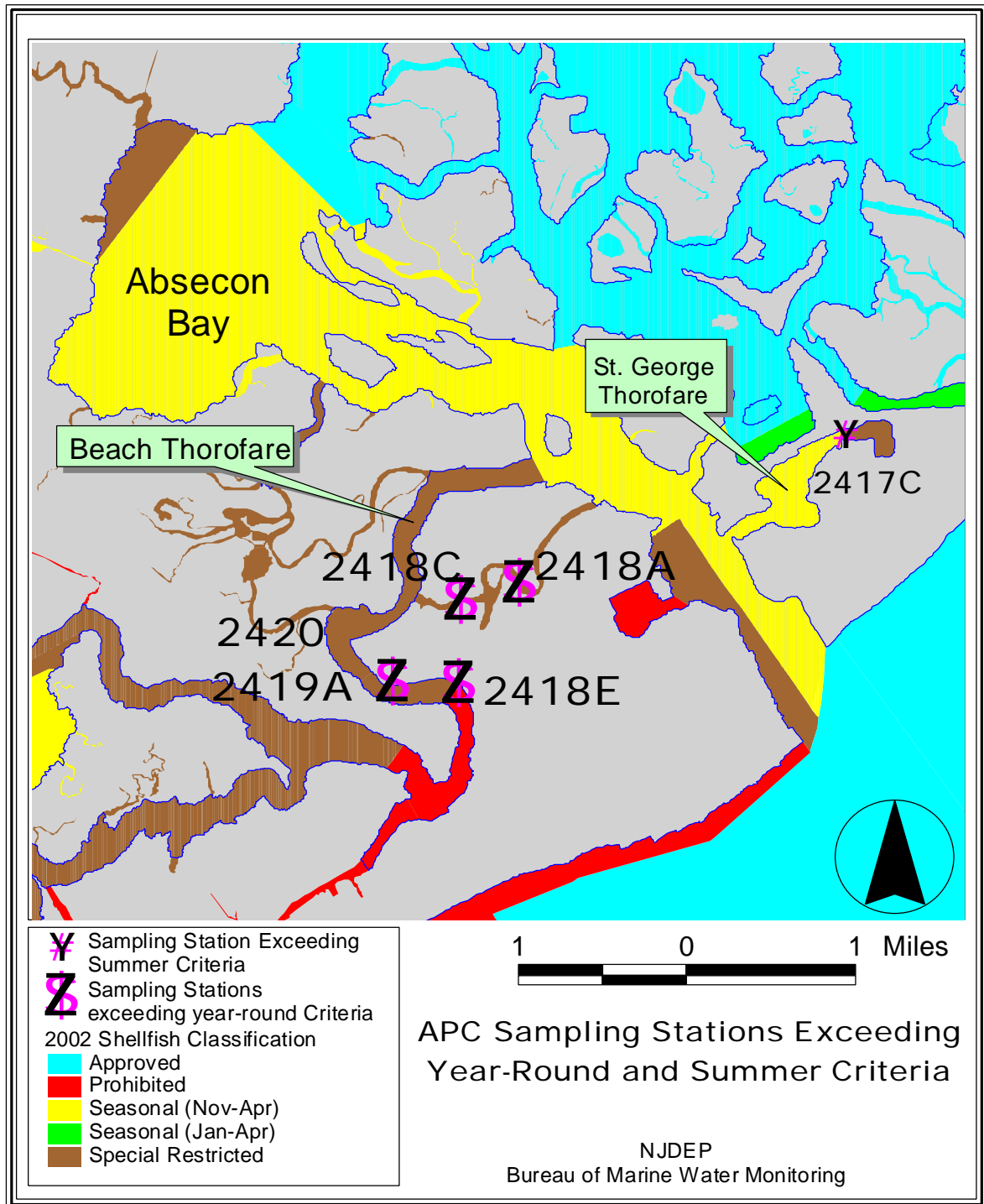
TABLE 7: TOTAL COLIFORM STATISTICAL SUMMARY (APC 1998-2002)

Station	Status	Year-Round			Summer			Winter		
		Geo-Mean	%>330 MPN	N	Geo-Mean	%>330 MPN	N	Geo-Mean	%>330 MPN	N
2207A	A	8.2	0.0%	49	7.8	0.0%	27	8.7	0.0%	22
2210C	A	8.8	2.0%	49	9.8	3.7%	27	7.8	0.0%	22
2210F	SJ	6.7	2.1%	48	7.8	3.7%	27	5.6	0.0%	21
2211	SJ	8.5	2.0%	49	8.7	0.0%	27	8.2	4.5%	22
2212A	SJ	10.0	0.0%	49	10.2	0.0%	27	9.7	0.0%	22
2214	SJ	11.6	2.0%	49	12.1	0.0%	27	11.0	4.5%	22
2215A	SJ	9.9	0.0%	49	10.0	0.0%	27	9.7	0.0%	22
2216A	P	11.2	4.1%	49	12.7	7.4%	27	9.5	0.0%	22
2218	SJ	11.3	4.0%	50	18.9	3.7%	27	6.2	4.3%	23
2218A	SJ	6.7	4.0%	50	9.3	7.4%	27	4.6	0.0%	23
2218B	A	6.4	0.0%	49	7.8	0.0%	27	5.1	0.0%	22
2219A	A	8.0	4.0%	50	11.0	3.7%	27	5.5	4.3%	23
2221	SJ	9.8	0.0%	50	13.4	0.0%	27	6.8	0.0%	23
2221A	A	8.7	2.0%	50	10.8	3.7%	27	6.8	0.0%	23
2223B	A	5.0	0.0%	50	4.9	0.0%	27	5.1	0.0%	23
2226A	A	6.1	2.0%	49	6.2	0.0%	26	6.0	4.3%	23
2227	A	7.9	4.1%	49	7.6	7.7%	26	8.3	0.0%	23
2229A	A	11.3	8.5%	47	11.7	8.0%	25	10.9	9.1%	22
2414	SR	11.1	2.0%	50	12.7	3.7%	27	9.4	0.0%	23
2415	SR	17.9	6.0%	50	20.2	7.4%	27	15.5	4.3%	23
2417	SR	6.9	4.0%	50	9.9	7.4%	27	4.5	0.0%	23
2417A	SR	9.5	8.0%	50	12.0	7.4%	27	7.2	8.7%	23
2417B	SR	10.6	8.2%	49	13.5	7.4%	27	7.9	9.1%	22
2417C	SR	15.9	8.0%	50	27.6	14.8%	27	8.3	0.0%	23
2417D	S	5.8	0.0%	50	6.9	0.0%	27	4.7	0.0%	23

WATER QUALITY SUMMARY: APC STATIONS (CONTINUE)

Station	Status	Year-Round			Summer			Winter		
		Geo-Mean	%>330 MPN	N	Geo-Mean	%>330 MPN	N	Geo-Mean	%>330 MPN	N
2417E	S	6.6	0.0%	50	6.7	0.0%	27	6.6	0.0%	23
2417F	S	6.0	0.0%	50	6.4	0.0%	27	5.5	0.0%	23
2417G	S	6.9	4.0%	50	9.6	7.4%	27	4.6	0.0%	23
2417H	S	6.7	0.0%	50	7.5	0.0%	27	5.9	0.0%	23
2418A	SR	33.2	14.0%	50	39.1	18.5%	27	27.3	8.7%	23
2418C	SR	49.2	14.0%	50	58.2	11.1%	27	40.4	17.4%	23
2418E	SR	127.0	34.0%	50	174.2	40.7%	27	87.6	26.1%	23
2419A	SR	90.6	28.0%	50	102.6	25.9%	27	78.3	30.4%	23
2420	SR	31.2	10.0%	50	36.7	14.8%	27	25.8	4.3%	23

TABLE 8: TOTAL COLIFORM STATISTICAL SUMMARY (SRS 1998-2002)

Station	Status	Year-Round			Summer			Winter		
		Geo-Mean	Est. 90th	N	Geo-Mean	Est. 90th	N	Geo-Mean	Est. 90th	N
2101A	A	4.9	10.9	41	4.4	8.1	22	5.6	14.5	19
2101C	A	4.9	13.0	41	5.4	16.1	22	4.4	9.9	19
2101D	LA	6.7	28.2	40	10.3	50.1	21	4.2	11.1	19
2102	A	4.4	9.7	31	3.8	6.2	17	5.3	14.5	14
2102A	A	5.0	14.5	41	4.8	13.7	22	5.1	15.9	19
2102C	A	5.9	25.5	41	8.1	48.4	22	4.1	8.9	19
2103A	A	6.3	22.8	41	6.6	27.0	22	5.9	19.1	19
2103E	A	8.6	56.4	41	12.7	117.2	22	5.5	18.2	19
2104	A	5.6	18.6	41	7.0	26.4	22	4.4	11.5	19
2104B	A	4.9	13.5	40	5.3	15.3	21	4.4	12.0	19
2104E	A	4.6	10.9	41	5.8	15.5	22	3.5	6.1	19
2106A	A	4.5	11.3	41	5.5	16.8	22	3.6	6.0	19
2200A	A	7.1	30.0	40	10.5	53.6	22	4.4	10.5	18
2202B	A	4.8	11.2	41	4.9	11.1	22	4.6	11.6	19
2204B	A	5.4	19.5	40	6.3	27.3	22	4.5	12.3	18
2205A	A	6.5	23.8	40	7.5	35.2	22	5.4	13.5	18
2208D	A	4.5	11.9	40	4.4	10.3	22	4.6	14.2	18
2209D	A	4.5	11.3	40	4.7	13.2	22	4.2	9.3	18
2209G	A	6.4	25.6	40	7.7	29.6	22	5.2	21.0	18
2220	A	7.4	33.4	40	8.8	45.5	22	5.9	22.4	18
2224A	A	4.9	15.2	41	5.9	24.7	22	3.9	7.0	19
2230	A	5.1	13.2	41	6.1	18.3	22	4.2	8.3	19

Station	Status	Year-Round			Summer			Winter		
		Geo-Mean	Est. 90th	N	Geo-Mean	Est. 90th	N	Geo-Mean	Est. 90th	N
2300	A	4.8	19.0	41	5.9	29.0	22	3.8	10.7	19
2300B	A	3.7	6.6	41	3.9	7.5	22	3.5	5.7	19
2300C	A	4.3	10.4	40	4.3	10.6	22	4.2	10.3	18
2300D	A	3.9	10.9	40	4.0	8.2	22	3.9	14.5	18
2300E	S	3.9	8.1	49	4.2	9.0	19	3.8	7.6	30
2301	SR	15.2	148.9	43	27.8	310.5	22	8.1	52.1	21
2301B	SR	6.1	20.3	43	7.7	32.0	22	4.7	11.1	21
2302	A	7.7	582.5	41	14.2	141.5	22	3.8	7.2	19
2303B	A	4.3	9.9	41	3.9	8.6	22	4.8	11.6	19
2303C	A	4.3	9.5	40	4.2	9.3	21	4.5	9.9	19
2304	A	4.9	16.0	43	3.5	5.8	22	6.9	31.4	21
2304C	A	4.4	10.7	41	4.1	8.7	22	4.9	13.5	19
2305C	A	7.7	31.7	41	10.0	36.4	22	5.7	25.3	19
2306	A	6.0	22.6	43	6.5	25.9	22	5.5	20.2	21
2306C	A	6.4	34.3	43	7.1	54.3	22	5.8	19.9	21
2307	S	12.5	89.3	48	27.0	250.1	19	7.5	33.3	29
2307A	S	5.1	14.5	45	6.5	25.6	18	4.3	8.8	27
2307B	A	7.0	38.3	43	7.1	58.2	22	6.9	22.8	21
2308	A	9.3	65.9	43	13.2	126.6	22	6.5	28.8	21
2308A	A	5.4	16.0	43	4.5	10.7	22	6.5	23.0	21
2308B	A	10.0	44.4	43	10.3	47.1	22	9.6	43.2	21
2308C	A	8.6	36.2	43	12.5	62.1	22	5.8	16.8	21

Station	Status	Year-Round			Summer			Winter		
		Geo-Mean	Est. 90th	N	Geo-Mean	Est. 90th	N	Geo-Mean	Est. 90th	N
2309A	A	6.9	25.1	41	8.7	38.4	22	5.2	13.6	19
2309C	A	4.4	10.2	41	5.2	13.5	22	3.7	6.9	19
2309D	A	6.5	23.5	41	9.1	37.3	22	4.4	11.1	19
2310B	A	5.3	13.8	41	6.4	18.3	22	4.2	9.2	19
2311B	A	5.3	19.2	39	6.8	35.0	21	4.0	6.7	18
2311D	A	4.8	13.6	41	5.7	20.0	22	3.9	7.7	19
2400	A	6.2	16.9	48	6.6	22.2	19	5.9	14.0	29
2400A	A	4.6	11.6	48	5.3	16.2	19	4.2	9.0	29
2400B	A	7.2	23.6	43	8.6	28.3	22	6.0	19.3	21
2401	SR	15.5	79.4	48	16.4	93.6	19	14.9	73.2	29
2401A	SR	8.3	37.8	48	7.3	27.6	19	9.1	46.5	29
2401C	S	9.1	35.6	48	6.5	21.3	19	11.3	46.9	29
2401E	S	6.6	21.6	48	5.8	14.8	19	7.1	27.2	29
2402	SR	8.7	44.3	48	6.5	31.6	19	10.5	54.2	29
2402A	SR	8.4	35.7	48	5.7	19.7	19	10.9	48.5	29
2403	S	9.6	45.2	48	4.5	9.1	19	15.8	80.2	29
2403B	S	9.6	47.4	48	9.2	47.7	19	9.8	48.6	29
2404C	S	9.0	34.9	49	9.2	32.9	19	8.9	36.9	30
2405	S	9.3	42.0	48	4.8	14.9	19	14.3	63.2	29
2405C	S	12.3	69.6	48	10.1	40.1	19	14.0	97.1	29
2406	S	7.8	41.1	48	4.6	13.0	19	11.0	70.3	29
2406A	S	14.5	119.8	48	6.3	28.6	19	25.0	220.5	29

WATER QUALITY SUMMARY: SRS STATIONS (CONTINUE)

Station	Status	Year-Round			Summer			Winter		
		Geo-Mean	Est. 90th	N	Geo-Mean	Est. 90th	N	Geo-Mean	Est. 90th	N
2406B	S	14.2	62.0	48	13.6	60.9	19	14.6	64.4	29
2407	S	6.7	19.4	48	7.0	26.0	19	6.4	15.8	29
2407B	S	10.3	50.7	48	9.9	43.7	19	10.6	57.1	29
2409A	SR	7.4	26.5	49	8.3	24.8	19	6.9	27.6	30
2411A	S	6.9	27.6	48	10.5	49.0	19	5.2	16.9	29
2412A	S	4.8	11.5	48	4.7	11.2	19	4.9	11.9	29
2412B	S	5.1	17.8	49	5.8	23.7	19	4.7	14.8	30
2412C	S	6.9	26.9	49	6.9	24.9	19	6.9	28.8	30
2412E	S	5.8	20.9	49	5.4	16.7	19	6.1	24.3	30
2412H	S	4.2	9.2	49	4.2	9.6	19	4.3	9.0	30
2413	SR	5.0	15.0	49	5.2	12.6	19	4.8	16.7	30
2416	S	3.4	5.0	49	3.2	4.5	19	3.4	5.3	30
2416L	SR	5.1	18.2	49	5.0	16.5	19	5.1	19.7	30
2416S	SR	5.2	17.9	49	6.1	21.8	19	4.7	15.9	30
2418	S	8.3	54.0	49	11.7	142.1	19	6.7	24.9	30

TIDAL EFFECTS

A significant tidal effect was found at ten stations throughout the SE-2 area. Two sampling stations were APC stations (2218B and 2417F) and the other eight were SRS sampling stations. The majority of these stations were located within the vicinity of Reeds Bay. See Figure 25 for station location. These stations are listed below in Table 9. Tidal impacts were evaluated by performing a t-test using the Total Coliform MPN value. In order for a station to have a tidal component, t-probability must be less than 0.05, but not zero. The MPN values from samples collected during ebb tide were then compared with those collected during

flood tide. Eight out of ten stations had a higher MPN value during flood tide than at ebb tide. Five of these stations are located in Reeds Bay, by Somers Cove and Turtle Cove. Surrounding this area are salt marshes. These salt marshes are home to many animals, such as raccoons, squirrels, and birds. When flood tides occur, animals' feces from nearby marshes can be sweep up and carried into the bay, thus contributing to higher total and fecal coliform counts. Only two stations (2311B and 2300C) were affected by ebb tide. Station 2311B is situated in the Steelman Thorofare, and Station 2300C is located in Gull Island Thorofare.
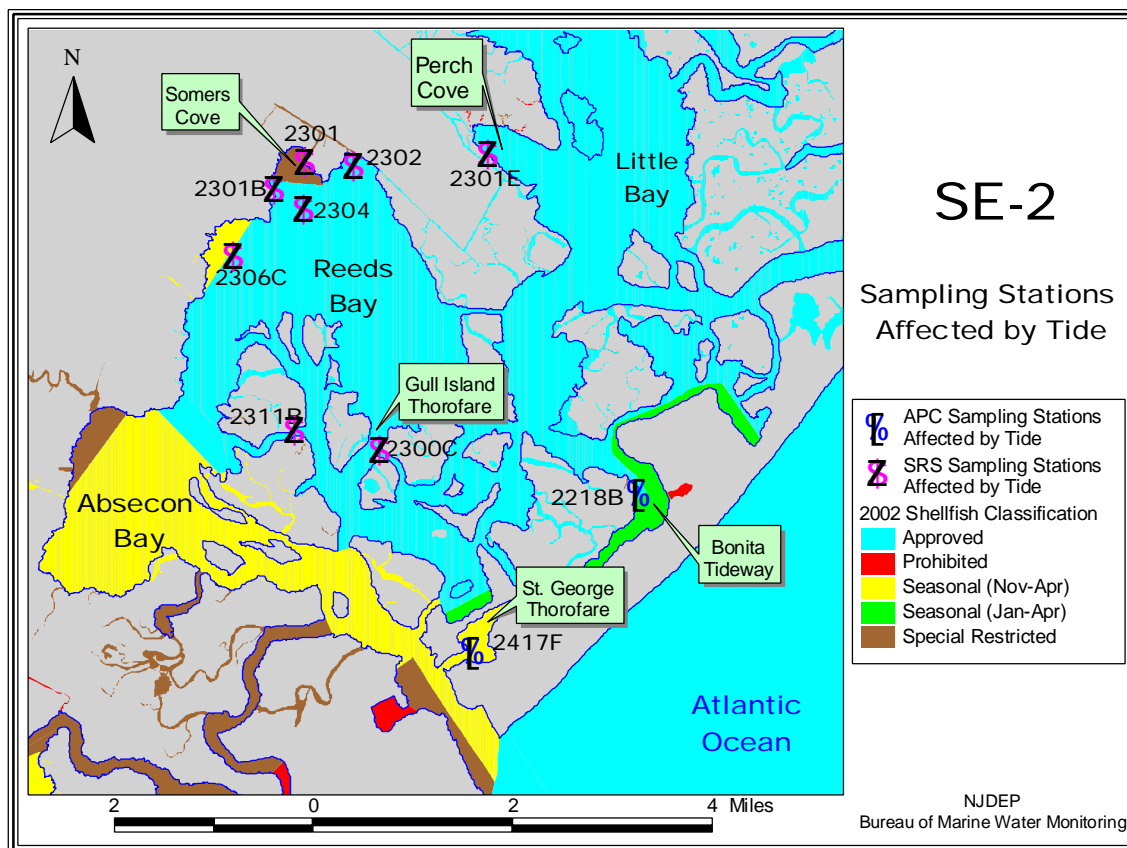
FIGURE 25: SAMPLING STATIONS AFFECTED BY TIDE

TABLE 9: TIDE STATISTICS

| Station	Geometric Mean Total Coliform MPN		Probability>[T]
	Ebb	Flood	
2103E	5.0	10.6	0.046
2218B	4.6	11.2	0.009
2300C	4.4	3.3	0.030
2301	4.5	20.0	0.001
2301B	3.8	6.6	0.017
2302	3.9	8.4	0.033
2304	3.1	5.1	0.005
2306C	3.1	6.9	0.001
2311B	5.9	3.1	0.002
2417F	4.2	9.4	0.003

RAINFALL EFFECTS

Non-point source pressures on shellfish beds in New Jersey originate in materials that enter the water via stormwater. These materials include bacteria, as well as other waste that enters the stormwater collection system.

Historical data comparing the difference between coliform levels measured after rainfall with those during dry periods were compared to generate the map below. The Bureau of Marine Water Monitoring has begun to identify particular storm water outfalls that discharge excessive bacteriological loads during storm events (see Figure 26). In some cases, specific discharge points can be identified. When specific outfalls are identified as significant sources, the Department works with the county and municipality to further refine the source(s) of the contamination and implement remediation activities. It should be noted that a particular short-term data set might not indicate significant rainfall effects even if the historical data indicate that a significant effect occurs in a particular area.

This is due to one or more of the following factors:

- ✍ Data during the short term may consist of primarily rainfall data or dry weather data. In this case, if there are insufficient data points in each category, the test for significance can not be done.

- ✍ Data collected after rainfall in the normal sampling regime may miss the effects of the 'first flush'.

- ✍ Rainfall data are based on the closest established NOAA station. Since rainfall patterns along the coastline, particularly during the summer months, tend to include locally heavy rainfall, the rainfall amounts recorded at the NOAA station may not accurately reflect the rainfall at the sampling station(s).
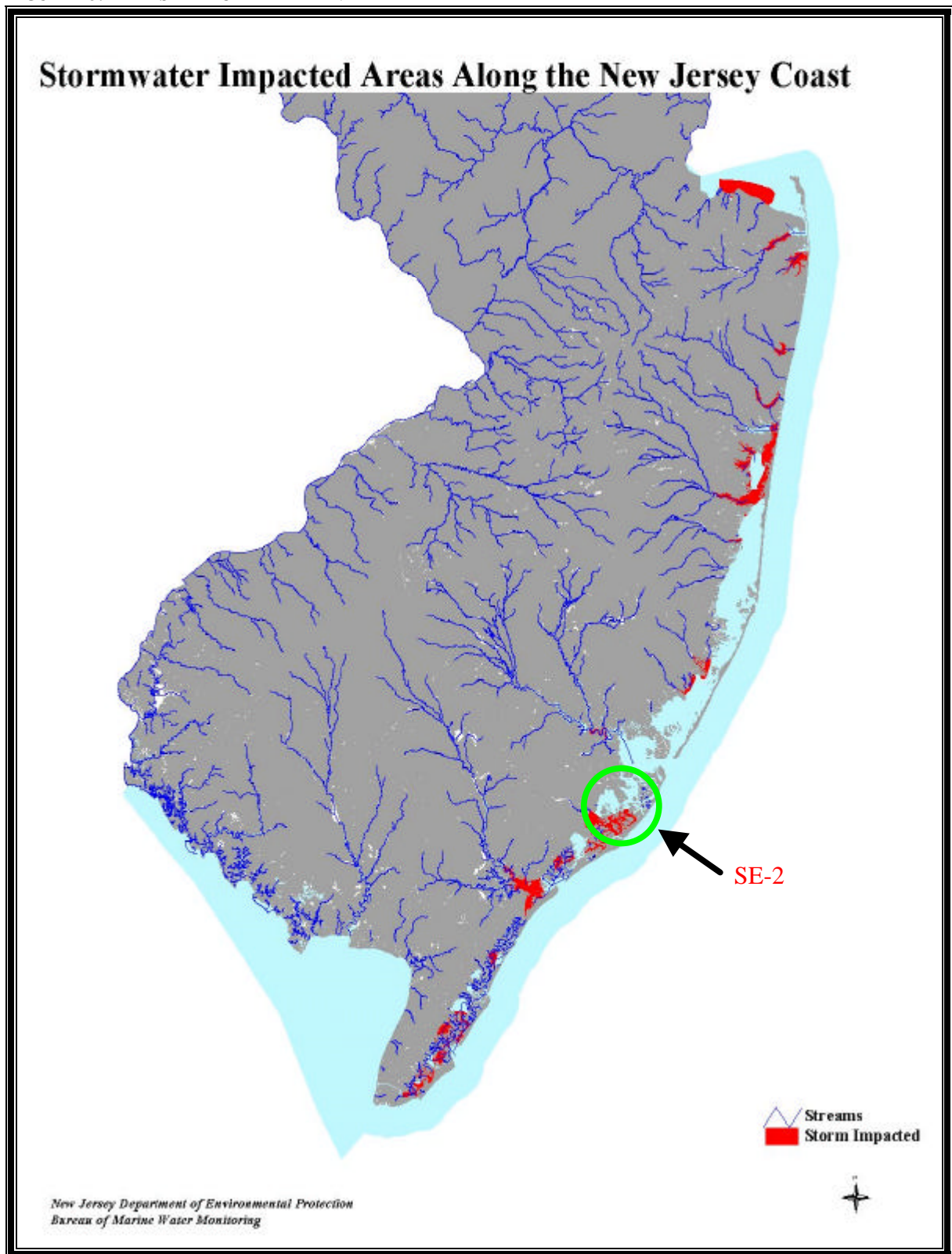
SEASONAL EFFECTS

Seasonal effect was assessed using a t-test to compare the Total Coliform MPN values from samples collected during the summer season versus samples collected during the winter months. To have a seasonal component, t-probability must be less than 0.05, but not zero. Fourteen sampling stations in the SE-2 area were found to exhibit a t-probability of less than 0.05. These stations are listed below in Table 10. There were four APC sampling stations (2218, 2218A, 2417, and 2417G) that had a seasonal component. Sampling stations (2218 and 2218A) are located in the Bonita Tideway and the other two stations (2417 and 2417G) are situated within St. Georges Thorofare. The locations of the other sampling stations are scattered throughout the SE-2 area. See Figure 27 for station location. Twelve out of fourteen stations had a summer component. Only two stations (2406 and 2304) were affected by the winter season. Station 2406 is located in the Absecon Bay, and Station 2304 is positioned in Somers Cove area.

TABLE 10: SEASON STATISTICS

Station	Total Coliform Geometric Mean		Probability > [T]
	Summer	**Winter**	
2101D	10.3	4.2	0.0087
2104E	5.8	3.5	0.0130
2106A	5.5	3.6	0.0449
2200A	10.5	4.4	0.0090
2218	18.9	6.2	0.0141
2218A	9.3	4.6	0.0339
2302	14.2	3.8	0.0029
2304	3.5	6.9	0.0183
2307	27.0	7.5	0.0086
2308C	12.5	5.8	0.0222
2309D	9.1	4.4	0.0160
2406	4.6	11.0	0.0105
2417	9.9	4.5	0.0446
2417G	9.6	4.6	0.0377

FIGURE 27: SAMPLING STATIONS AFFECTED BY SEASON
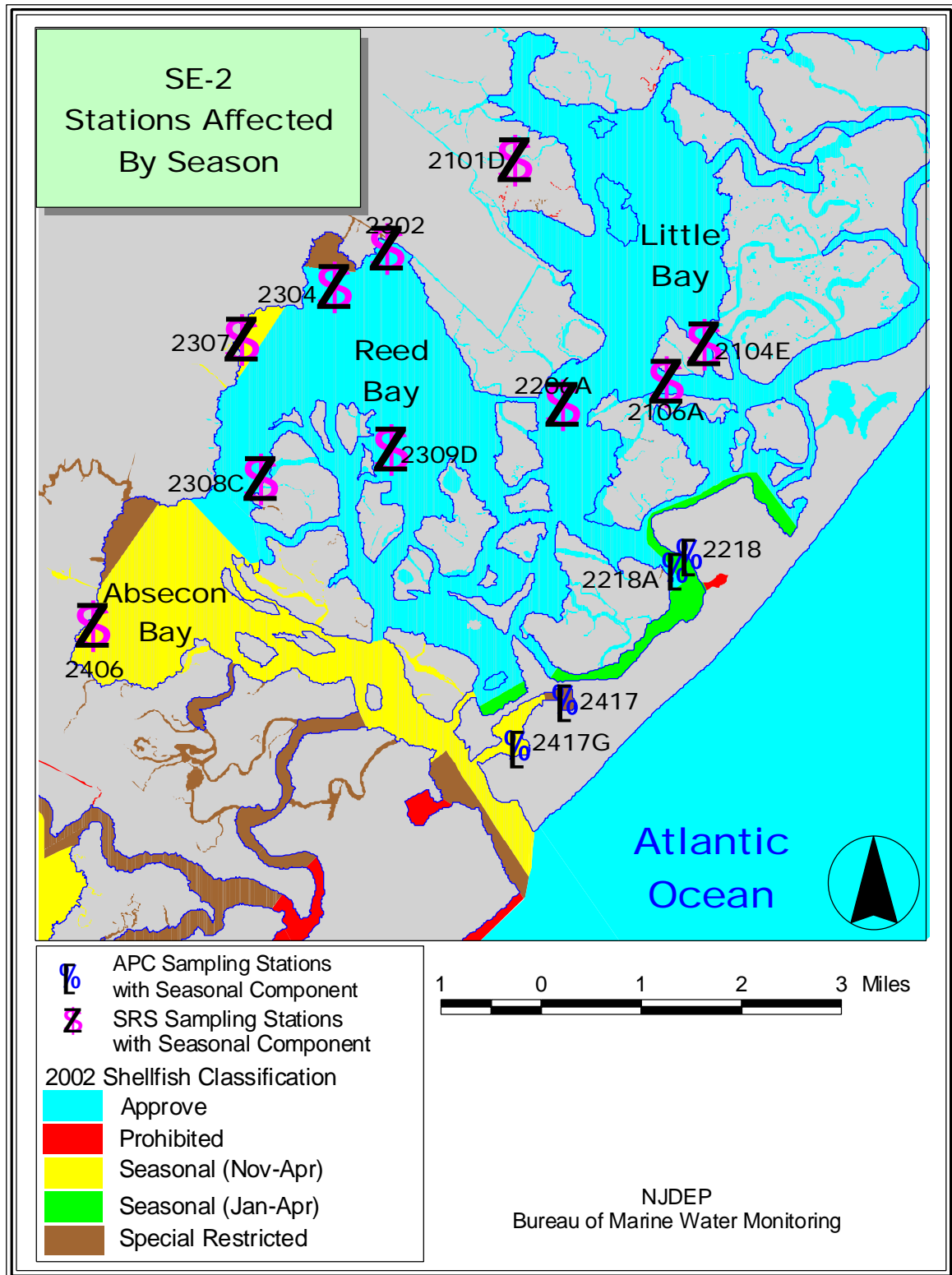
INTERPETATION AND DISCUSSION OF DATA

BACTERIOLOGICAL

The criteria for acceptability of shellfish growing water was based on the bacterial parameters set by the National Shellfish Sanitation Program (NSSP). Each state adopts either the Total Coliform criteria or the Fecal Coliform criteria for determining water quality.

The New Jersey Department of Environmental Protection had always based its water classification on the results generated from the Total Coliform test. Even though water classification is based on the Total Coliform criteria, the Bureau of Marine Water Monitoring does take corresponding samples for Fecal Coliform analysis. These data are however utilized as adjunct information and are not used for classification of shellfish growing waters. The NSSP criteria can be found on Table 2 and Table 3.

The bacteriological data collected for this report are listed in the Appendix. These data were collected under both the Adverse Pollution Condition and Systematic Random Sampling strategies.

High levels of Total Coliform were detected at six stations located within the vicinity of Beach Thorofare and St. Georges Thorofare. These stations were 2417C, 2418A, 2418C, 2418E, 2419A, and 2420, which were all APC sampling stations. Five sampling stations (2418A, 2418C, 2418E, 2419A, and 2420) resulted in high Total Coliform counts year-round, while the other stations (2417C) had

detected for high Total Coliform only during the summer season.

The criteria for *Approved* classification for Adverse Pollution Condition sampling strategy are: the geometric mean can not exceed 70 MPN/100 mL and no more than 10 percent of the samples set can exceed 330 MPN/100 mL. Areas classified as *Special Restricted* must meet the criteria of 700 MPN/100 mL and no more than 10 percent of the samples can exceed 3300 MPN/100 mL. The results from these six stations indicated that they had failed to meet the *Approved* criteria, but were within the *Special Restricted* specification. The current classification for this area is *Special Restricted*; therefore, no further assessments were required.

There were fourteen sampling stations with a seasonal component and ten sampling stations with a tidal component. The bacteriological levels for these sampling stations were very minimal. Even though, these stations failed to meet the t-probability of less than 0.05, the statistical data indicated that the geometric mean or MPN value for each of the sampling stations was far less than the criterion set by the NSSP. In this case, seasonal and tidal components had no major impact on the SE-2 area; therefore, no downgrade of water was necessary. Based on the evaluation of these data, the waters within SE-2 were accurately classified.
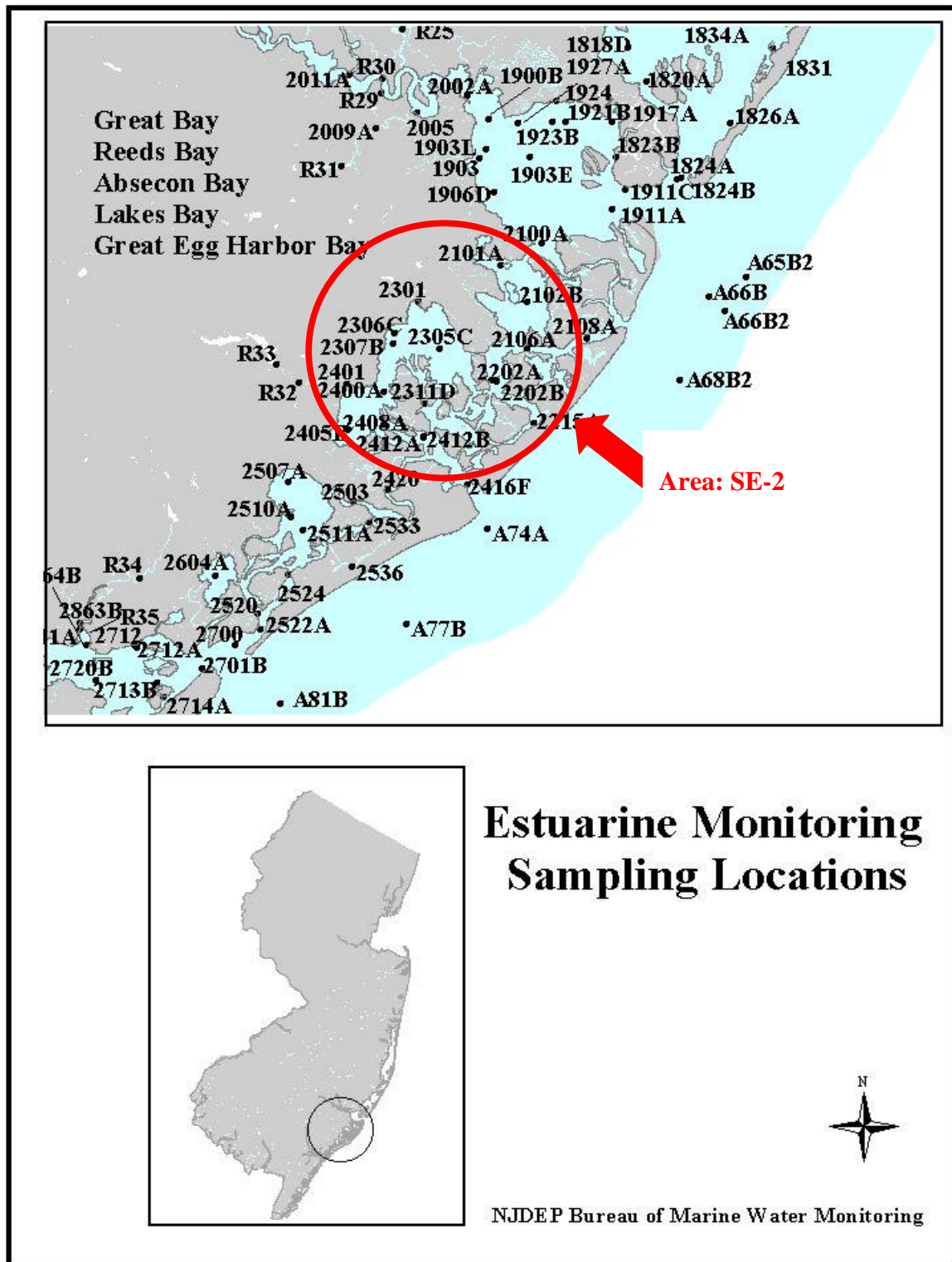
NUTRIENTS

There are sixteen stations in this shellfish growing area that are sampled under the estuarine monitoring program for chemical parameters including nutrients. These sixteen nutrient stations are 2101A, 2102B, 2106A, 2108A, 2202B, 2301, 2305C, 2306C, 2307B, 2311D, 2400A, 2401, 2405B, 2408A, 2412A, and 2420. The results below were generated using the information gathered from 1997 to 1999. Table 11 shows the different chemical parameters that were tested in the SE-2 area.

The location of these sampling stations can be found on Figure 28. More detailed information concerning dissolved oxygen and nutrient levels can be found in the Estuarine Monitoring Report published by the NJDEP. The latest report (New Jersey Ambient Monitoring Program: Report on Marine and Coastal Water Quality - 2000) is available from the Bureau of Marine Water Monitoring.

TABLE 11: NUTRIENTS DATA FOR SHELLFISH GROWING AREA SE-2

	Area of SE-2					
	BEACH THOROFARE	**REED BAY**	**ABSECON CREEK**	**ABSECON BAY**	**ABSECON INLET**	**LITTLE BAY**
TEMP (^{o}c)	15.8	16.7	17.2	16.1	14.0 – 17.2	16.6
SALINITY (PPT)	31.0	30.1	24.8	30.8	24.8 – 32.2	30.2
SECCHI (ft)	3.5	3.1	3.1	3.4	2.9 – 4.7	3.7
TSS (mg/L)	36.5	49.7	92.0	61.1	36.5 – 92.0	51.4
DO % SAT (mg/L)	59.3	50.6	56.1	51.8	50.6 – 88.1	57.7
NH$_3$ (ug N/L)	64.7	98.8	121.5	75.6	28.9 – 121.5	51.2
NO$_3$ (ug N/L)	33.7	28.5	32.1	21.8	12.3 – 37.3	21.3
PO$_4$ (ug P/L)	38.4	35.9	31.4	32.9	20.3 – 45.6	26.2
TON (ug N/L)	315.1	385.9	408.4	305.7	305.7 – 408.4	330.6
N:P	3.4	3.9	5.8	3.4	1.9 – 5.8	2.8
Fecal Coliform MPN (geometric mean)	24.3	4.5	37.2	6.1	4.5 – 37.2	6.5

Estuarine Monitoring Sampling Locations

NJDEP Bureau of Marine Water Monitoring

CONCLUSIONS

BACTERIOLOGICAL EVALUATION

The water quality for the SE-2 area in recent years has been exceptionally good. Based on the water quality data obtained between January 1998 and December 2002, the results for all of the sampling stations were within NSSP *Approved* or *Special Restricted* criteria. At this time, it is recommended that current classification remain the same.

RECOMMENDATIONS

BACTERIOLOGICAL EVALUATION

There are no changes in the water classification recommended for the SE-2 area at this time. Continue the monitoring schedule as planned.

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NOAA. National Climatic Data Center website located at www.erh.noaa.gov/er/box/dailystns.shtml.

U.S. Census Bureau. www.census.gov/

U.S. Environmental Protection Agency. www.epa.gov/owow/

USGS. www.usgs.gov/

ACKNOWLEDGMENTS

APPENDICES

A.   Statistical Summaries

          Year-round

          Winter Only

          Summer Only

B.   Seasonal Evaluation

C.   Precipitation

          Rainfall Correlation

          Cumulative Rainfall

          Wet Weather Statistical Summary

          Dry Weather Statistical Summary

D.   Tidal Evaluation

E.   Data Listing - 1998 through 2002

Ambient Monitoring Program

Reappraisal Report for the SE-2 Area:

Absecon Bay, Reeds Bay,
Little Bay, and Beach Thorofare

March 2004

Department of Environmental Protection

Bradley Campbell, Commissioner

State of New Jersey

James E. McGreevey, Governor